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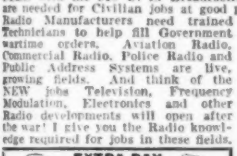

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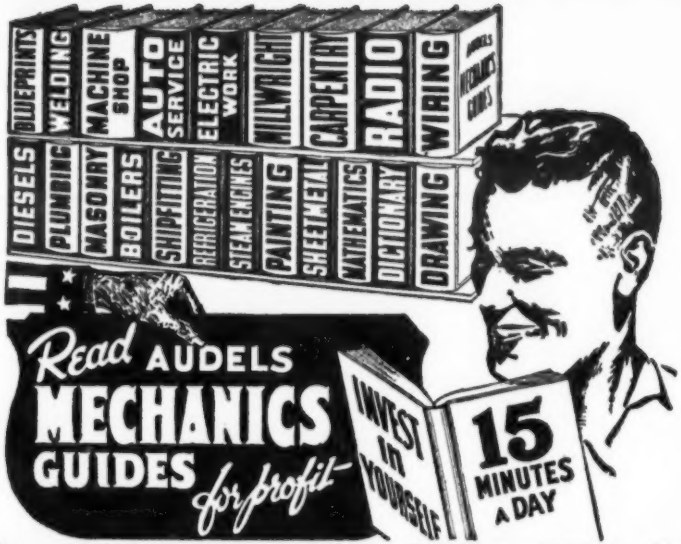

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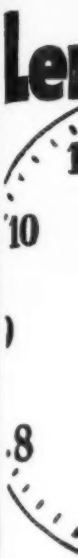

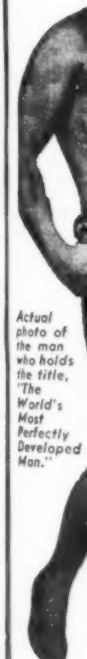

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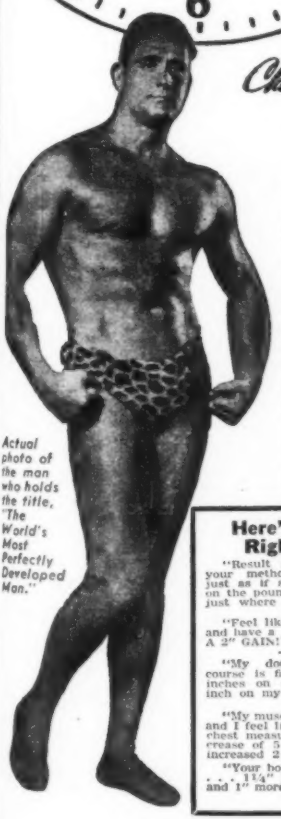

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Are you ALL MAN—tough-muscled, on your toes every minute, with all the up-and-at-'em that can lick your weight in wildcats? Or do you need the help I can give you—the help that has already worked such wonders for other fellows, everywhere?

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YOUR INVENTION CLINIC

Conducted by

JOSEPH H. KRAUS

Mr. Kraus has been giving advice to inventors for more than 20 years. He will attempt to answer as many letters from inventors as possible in his column each month. Mr. Kraus will "call his shots as he sees them" in this column. Thoroughly versed on inventions and inventions procedure, he will never, under any circumstances, disclose any valuable secrets. He cannot answer questions relating to patent law. For such information, the Editors suggest you communicate with any one of the patent attorneys who advertise in MECHANIX ILLUSTRATED.

Rivet Drill

Sgt. H. C. Shoffner, Amarillo Army Air Field, Amarillo, Texas, has designed a mechanism to simplify the drilling of "ice box rivets." He submits a sketch of the mechanism and asks for our opinion.

ANSWER: *We would recommend that you have a patent search made on this invention. We believe that the idea cannot be protected very basically because the mechanism is somewhat similar to electric tools which are used for tightening nuts on bolts. Nevertheless, you show modifications which might be looked upon as possessing sufficient novelty to permit patenting.*

We suggest that you communicate with a patent attorney immediately and have him institute a search. If the search reveals that the item is patentable, further action would be indicated, particularly because this invention has both a war and peace time market.

Colored Beam Flashlight

H. C. Regier, Yuba City, Calif., states that he has modified a purchased flashlight so that he is able to produce a beam of white or red light.

ANSWER: *We doubt that the modification you recommend is patentable. The only thing you did was to substitute a piece of colored material for other material now found in that flashlight. In our opinion, this does not make a patentable item. Aside from this, flashlights which throw a red, yellow, green or white beam merely by manipulating a small trigger mechanism have been sold in this country.*

We advise against further action.

Vertically Rising Airplane

Pvt. Everett E. Ball, Farrant Field, Forth Worth, Texas, sends us a sketch of an airplane with vertically set propellers in the wing arranged to produce a vertical lift. He states: "Some of the boys around here seem to think it will work; others say it will not work at all. I would like your advice as to whether it will work or not."

ANSWER: *In 1924 the details for the construction of a three-foot model airplane made almost exactly as you describe, appeared in a popular scientific magazine.*

In our opinion, this type of plane does not offer the advantages of the modern helicopter nor its ease of control, and while it is an interesting novelty we believe that better planes serving a similar purpose have been demonstrated in full scale working models.

We advise against further action.

Toilet-Tissue Holder

Sgt. Elmer E. Greiman, Sioux Falls, S. D., submits a description and illustration for a bathroom toilet-tissue holder which automatically applies friction to the roll. This tends to brake the unraveling action. This holder can be made at no additional cost over present styles.

ANSWER: *There is no doubt that your construction is effective while a reasonably full roll of paper remains in the holder but as the diameter of this cylinder decreases there will be a tendency to side motion which is likely to be damaging to the edges of the paper and also binding on the roll itself.*

We recommend that you build an experimental model and test it out. Also, that after this model is built you try to modify the construction. You may hit upon a method which will work for both extremes; namely, the full roll and the almost exhausted roll.

We believe that it will be worth your while to continue these experiments at every opportunity.

Hydraulic Powered Boat

J. R. Kachelhoffer, Joliet, Ill., sends us details of a hydroplane in which water is taken in at the front and ejected forcibly through pumps at the rear. He requests that we keep details secret.

ANSWER: *The unfortunate part of this secret is that everyone knows about it. The squid uses this method for movement. Photos of full sized demonstration models of boats using this means of propulsion have appeared in this and other magazines. Similar systems were even suggested for lighter-than-air craft. Unfortunately, the mechanisms are not efficient. We feel sure there is nothing original here.*

[Continued on page 157]

INVENTORS AMERICA NEEDS YOUR IDEAS

In War and in Peace

Your country—in fact the whole civilized world—is in crying need of new ideas—these new ideas, YOUR IDEAS, must lead not only to victory in war but to prosperity in the peace which will inevitably follow. TIME MARCHES ON—today's inventions are tomorrow's craftsmanship, and post-war prosperity and readjustment will demand the creation of thousands of simple things that will win recognition—perhaps wealth—for you. TIME MARCHES ON and you march with it—or it passes you by.

Peace Is Coming

Factories now converted to War Production for the duration are already buying new inventions. They must take up NEW IDEAS in order to continue in business when the war ends. That's the time when new improved articles will be rushed onto the market and the lucky patent holders will reap the profits.

NOW IS THE TIME TO PATENT YOUR INVENTION

No matter who you are, where you are—no matter what your invention is, NOW is the time to apply for a patent. By delaying you may not only lose your rights, but you may miss some immediate opportunity of making money. When a house is burning down, it's too late to get fire insurance. When a market already exists for your invention, then it may be too late for you to apply for a patent.

A PATENT NOW MEANS POST WAR PROFITS

Remember that you can sell your patent rights now, regardless whether or not your invention can be made and marketed for the duration, because manufacturers are buying patents today in order to have new merchandise on the market as soon as priority restrictions are removed. Remember, too, a Patent is good for 17 years. So get the FACTS by writing for our free "Patent Guide". Be safe—not sorry!

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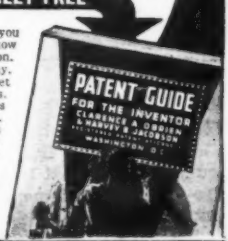

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CHIPS FROM THE EDITOR'S WORKBENCH

This convenient and attractive knee-hole desk shows what the workshop fan can do despite the wartime scarcity of materials. No new material was used—the entire desk having been built from an old bureau. But don't get the idea that such a method of obtaining material is too lengthy and difficult. The total working time, the builder informs us, was 36 hours, from the start of the dismantling job on the old bureau to the hand rubbing of the desk's finish. The builder is Stephen Cavell, 1036 Fox St., Bronx, N. Y. Mr. Cavell receives this month's Workbench $5.00 first award, and a Certificate of Merit.

The Winnah!

WE CAN say definitely now that the winners in the great MI "Buildwords" contest will be announced in the next issue of MECHANIX ILLUSTRATED—the August issue, on sale about July 7.

Last year we were able to make the announcement in our July issue. But this year the deadline for entries was extended 15 days, as you will remember, owing to the fact that magazines are going on sale at the newsstands later than usual because of wartime shipping restrictions. The later deadline, plus a flood of nearly 45,000 entries, made it impossible for us to judge the winners in time for a July announcement.

So be patient a bit longer. And be sure to buy your August issue of MI. YOU may be the winner of that great first prize, an Aeronca Defender training plane or $1,500.00 in War Bonds!

Next Month

AND while we're on the subject of the forthcoming August issue of MI, we'd like to tell you about some of the features we have lined up for it. We think it's going to be about as exciting and entertaining a magazine as you've ever seen. Here are just a few of the standouts:

WE RAMMED THE SIXTH ONE: a first person, eye-witness account by Seaman William Melchior of one of the most thrilling sea fights in the war, the encounter of the Coast Guard patrol cutter Campbell with six submarines, climaxed by the ramming and sinking of the last one.

YOUR POST-WAR VACATION: Wendell Willkie, in his new book, says he has a date with the president of a Mongolian republic for a "week-end hunting trip" as soon as the war is over. Mr. Willkie plans to fly to Mongolia, do some hunting and fly back home, all on a week end! Perhaps that will give you some conception of how the world and your vacation plans will be changed by the great advances in aviation and science in this war. But the immense progress of aviation is only a small part of it. All of the things you use for vacation fun—cameras, sporting goods and the like—are apt to be vastly improved when our war plants get back into normal peacetime production again. Donald G. Cooley gives you an exciting peek at your coming vacation thrills in his article which is eleventh in our series, "A World You Never Knew."

WILL THE EARTH SOCK JAPAN? An article read and approved by the nation's authorities on earthquakes, tells you why Mother Nature may beat America to the punch against the Nipponese.

MATTER—INSIDE OUT: Why do some meteors crash into the earth without leaving a trace of their ashes behind? Willy Ley, one of the world's greatest writers on science, comes up with an intriguing explanation of this mystery. He will tell you about the flaming projectile from the heavens that nearly blew up a sail boat in Long Island Sound—and the strange thing that happened to it when it struck earth.

[*Continued on page* 18]

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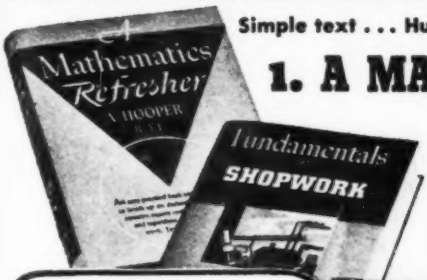

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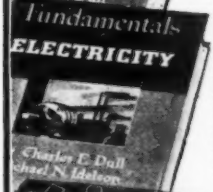

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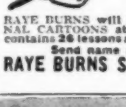

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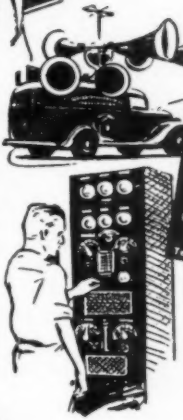

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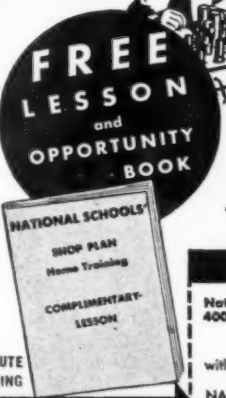

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Editor's Workbench Chips

[*Continued from page* 14]

MEDICINE'S MAGIC WAND: The story of the Moorhead foreign body locator, truly a magic wand for surgeons—an electric device which locates shrapnel and bullets in a wounded man and is saving many lives during war.

THE MAN WHO STAYED IN BED: Part II of the story of John Hays Hammond, Jr., the Modern Edison, which starts on page 58 of this issue.

BUILD A MOTOR SCOOTER! Complete plans for a scooter to beat gasoline rationing. For full details, see below.

ENGLAND'S WOODEN WONDER: Arch Whitehouse, America's outstanding aviation writer (you've seen his stories in The Saturday Evening Post) tells you the wonders of the new British Mosquito bomber—the fastest bomber in the world.

THE SCIENCE OF TACTICS: Major Malcolm Wheeler-Nicholson gives a fascinating account of how battle methods have developed from the days of the cave man through the Macedonian Phalanx up to the most modern tactics, in an article that will give you a much better understanding of what is going on in this war.

We think it stacks up to about as entertaining and informative an issue as we've ever brought you. Remember, due to the paper shortage, copies of MI are scarce. Better order your August copy of MECHANIX ILLUSTRATED now at your favorite newsstand. Or, better yet, assure yourself of a copy by sending $1.50 to Fawcett Publications, Inc., Greenwich, Conn., for a full year's subscription! You'll find a handy subscription coupon on page 150.

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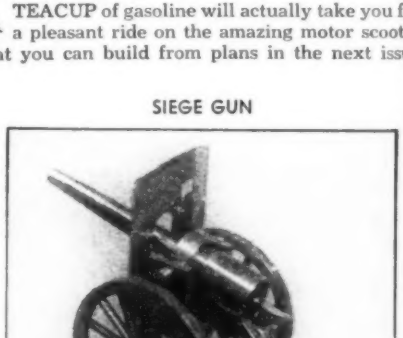

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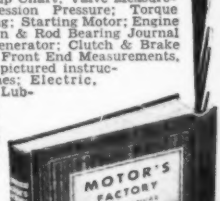

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Editor's Workbench Chips

of MI. The product of much experimental work, this ultra-modern machine embodies the latest developments in rugged and economical design.

The instructions for building it include clever ideas on possible sources of much of the material used in the construction. The frame, for example, can be made from an old broken down bed—and yet the completed scooter is so strong that it can carry the biggest of the heavyweights over rough country roads day in and day out. The entire gas tank is no bigger than a schoolboy's lunch box, and the chances are that you won't have to fill it very often, as the average scooter of this type can travel from New York to Philadelphia on one gallon of gas. You can probably carry enough fuel in a tomato can to take you on your average shopping trip. So if you've felt any pinch from gasoline rationing you won't want to miss Howard G. McEntee's article with plans and instructions for building this trim and fast super scooter. It's simple in design, and a beauty in appearance, and most important of all, it'll take you where you need to go without wasting a drop of fuel.

Helicopters

I SCOOPED the world on the story of the helicopter's coming of age—in an article published more than a year ago and in a story by Igor Sikorski, the inventor and the helicopter's "papa," published in our May, 1943 issue. Now, in current news releases, our faith in the helicopter is being fully justified.

The Army recently announced that helicopters are already in use to patrol a 500-mile "gap" in the mid-Atlantic which is out of range of the regular long-range reconnaissance planes. Up until the time the helicopters were put in use, this 500-mile stretch in the middle of the Atlantic could not be adquately covered by patrol planes.

Now, however, helicopters are taking off from the decks of regular merchant vessels, patrolling this Atlantic "blind spot" and returning to settle

BABY CAR HAS BABY TRAILER

Robert E. Lewry, 551 Cohannet Street, Taunton, Mass., built this all-wood midget car and its trailer. Its 1-horsepower motor gives it a speed of 20 miles an hour. Mr. Lewry is 15 years old, and apparently already a capable auto builder. This snapshot brings him a $3.00 Workbench award and a Certificate of Merit.

straight down on the mother ship's deck. The ability of the helicopter to stand still in midair makes it unbeatable for sub patrol duty. Whereas an ordinary patrol plane travels at 150 m.p.h. or more and often "loses" a suspicious shadow in the sea in its swift flight, the helicopter can "put on the brakes" and stop in midair the moment it sees a patch of ocean which needs investigating.

The British Admiralty has also announced its interest in the helicopter, and, in addition, the Canadian air forces recently ordered a number of the rotor-powered flying machines.

But we think the biggest helicopter news is not the wartime uses of the new machine so much as is its coming peacetime use. And the most exciting news in this field, we feel, is an announcement just issued by Northeast Airlines.

Northeast Airlines, operating throughout the New England States, has filed an application with the Civil Aeronautics Board for permission to establish helicopter service to carry airmail and air express to and from the rooftops of more than 400 postoffices and railroad stations in its territory.

LIGHTNING HITS THE WORKBENCH

This *Lightning* class sailboat was built by Tom B. Pearson and his brother, of Exeter, N. H., P.E.A. 172. Plans and instructions for building this well known and popular class boat appear in HOW TO BUILD 20 BOATS No. 8, which is now available.

The sails on the boat shown above were made by Ira S. Caldwell, of Beaufort, S. C., and Mr. Pearson tells us that he has received many compliments on them. "In closing," writes Mr. Pearson, "I wish to say that the boat has proven itself to be an excellent sailer in any weather, and I am looking forward, despite the war, to doing a lot of sailing on Portsmouth Harbor next summer."

A $3.00 Workbench award and a Certificate of Merit go to Mr. Pearson for this snapshot.

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Editor's Workbench Chips

This application is the first specific proposal to put the helicopter into actual commercial service.

So hold your breath! It won't be long until the dream of helicopters landing on rooftops all over the country will become a reality!

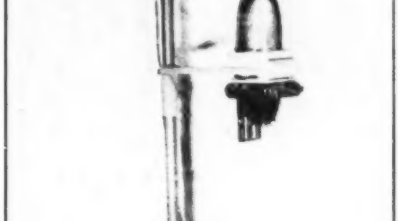
Enemy Patents

PATENT applications from enemy countries, as well as from lands at present in the hands of the enemy, are now being published by the Office of Alien Property Custodian here for the benefit of American firms engaged in war work. Format of publication is essentially the same as that of regularly published patents, and copies may be obtained from the U. S. Patent Office for ten cents each.

Patents have not yet been granted on these applications. Rights in the applications as they stand are now vested in the Alien Property Custodian, and it is his desire that they be made available to American producers for the furthering of the war effort.

Publication of annotated lists, by classes, has been begun in the Patent Office Gazette. Several hundred applications for chemical patents were listed in the Gazette for April 20, and a miscellaneous group, all the way from toys to fire-arms, in the issue for April 27. Since the total number of applications is approximately 3,000, it is anticipated that publications will be continued for about

$3.50 ENLARGER



Ellis A. Fuller, of 531 Barberry Lane, Louisville, Ky., built this 35 mm. enlarger for $3.50, and he informs us that he gets excellent results with it. He got his ideas for making it in MI, he writes. It's a nice job, and it brings Mr. Fuller a $3.00 Workbench award and a Certificate of Merit.

Editor's Workbench Chips

ten numbers of the Gazette, or possibly more.

A few applications, of particular military significance, are being withheld from publication.

Seeds Coated With Adhesive Envelopes

Means for making seeds more efficient, are covered by U. S. patent 2,313,057, granted to Albert C. Fischer of Chicago.

The invention, briefly, is a simple method for making each seed carry into the soil a small provision of fertilizer, fungicide, insecticide and (in the case of legumes) nitrogen-fixing bacteria that it needs in its first day or so after germination. This is accomplished by coating the seed with a water-soluble glue into which the initial lifeneeds of the seedling-to-be are impregnated.

To protect the seed against possible ill effects of too-long contact with fertilizer and fungicidal compounds, it is first covered with a coating of neutral glue, then with one or more coats containing the chemical and bacterial growth aids.

Enameled Pistons Cut Knocking

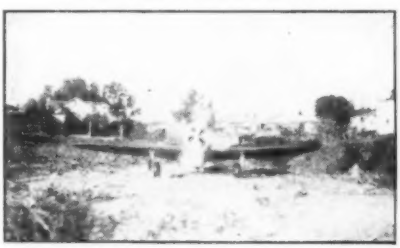
Enamel coatings on the face of a gasoline engine piston, and on the inner surface of the cylinder head, will materially reduce knocking and also minimize the formation of "shellac" or "varnish" on the piston skirts and hard carbon on the piston head, states Frederic H. Emery of Bedford, Ohio, in the preamble to patent 2,311,039.

To the glassy enamel, containing cobalt to make it stick better to the iron, the inventor also adds alumina or other refractory substance to increase its heat-resisting properties. The enamel, usually, though not necessarily minus the refractory, may also be applied on the underside of the piston and on the radiating fins of air-cooled motors, to speed up transfer and dissipation of heat.

Cored Glass Filaments

Glass filaments of spiderweb fineness, used in fabrics, insulation, etc., can be made stronger and

THUNDERBOLT TAKING OFF



Roy J. Cain, of 4328 E. 4th St., Los Angeles, Cal., is the builder of this P-47. It certainly looks like a real one as it heads toward the camera on a thrilling takeoff run—but it's just a model made from MI plans. Nice work, Mr. Cain! This snapshot nets a $3.00 Workbench award and a Certificate of Merit.

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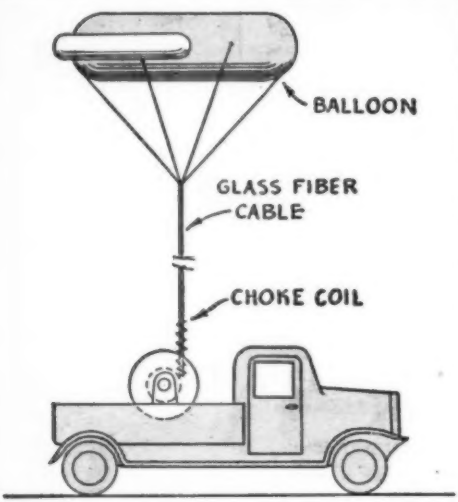
Popular Patents



Realizing that the weight of barrage balloon cables may limit the height to which the balloons may ascend, Rene Planiol of New York, N. Y., substitutes for the steel cables now used fiber glass cables. With such a cable, it is pointed out in the patent, balloons can be flown at heights as high as, or even higher than, the heights at which bombing or pursuit planes can fly. The filaments of glass fiber are coated with a mixture of rubber and casein to prevent friction. The coated fibers are preferably not twisted together but are kept parallel. This also reduces friction between the filaments of glass. According to this patent a cable of glass fibers of the same weight as that of steel and of the same tensile strength will be from one and a half to twenty times as long as the steel cable, depending upon the diameter of the glass filaments forming the glass cable. (No. 2,293,918.)

To keep the average soldier in trim the Quartermaster Corps spends $404.65 for the first year; of this $175.20 is for food; $162.05 for clothing; $15.79 for individual equipment; and $51.61 for barracks equipment.

A "mountain" of glass, nine miles long and four miles wide, exists in Yellowstone Park; it is called Obsidian Cliff, and at one time serious consideration was given to cutting the 200-inch telescope reflector out of this ready-made glass.

Soap and water are the best antidote to contact of the skin with lewisite or mustard gas, according to Dr. Joel Hildebrand of the University of California.

Editor's Workbench Chips

less brittle by a method developed by a German, Armand Lamesch of Herzogenrath, near Aachen. His patent, No. 2,313,296, is vested in the Alien Property Custodian.

Secret of the strengthened filaments is their use of two kinds of glass, of differing co-efficients of expansion. In one method of manufacture, a rod with a core of a second kind of glass is heated and spun out; in another, two concentric nozzles deliver the two kinds of glass simultaneously in molten condition. In any case, the resulting filament, no matter how finely drawn, still has the strong, sheathed-core structure.

Electrically Shaped Bomb Noses

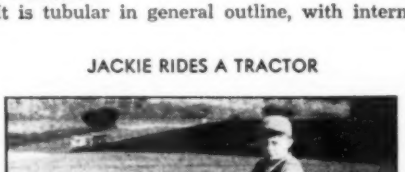
Two patents, both assigned to the A. O. Smith Corporation of Milwaukee, cover electrical shaping and forging processes for forming bomb noses on tubular steel bodies. They are the claims respectively of William C. Heath (No. 2,313,067) and Warren F. Heineman (No. 2,313,068). In both, the rounded point is formed by the pressure of rotating dies after the end of the tubing has been subjected to the necessary softening by means of high-frequency electric current.

Climb-Preventer for "Tommy-Guns"

Terrible ammunition-waster is the tendency of submachine ("Tommy") guns and automatic rifles to "climb"; it is difficult even for experienced gunners to keep their muzzles at proper elevation when full-automatic fire is on. To overcome this tendency, Eugene G. Reising, well-known gunmaker of Hartford, Conn., has developed a simple muzzle attachment on which he has received patent 2,313,669.

It is tubular in general outline, with internal

JACKIE RIDES A TRACTOR



John G. Domer, of Canaan, Conn., built this baby tractor for his son, Jackie, who is shown at the wheel. A Model T rear end, motorcycle transmission, and a 1 h.p. Briggs & Stratton engine take care of the power. This snapshot nets Mr. Domer a $3.00 Workbench award and a Certificate of Merit.

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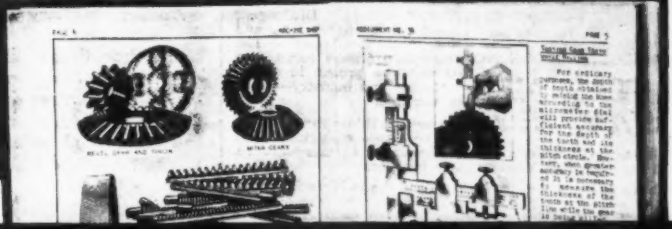

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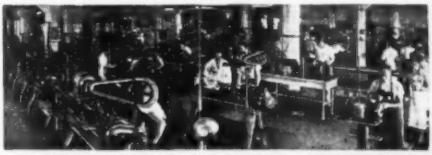

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Editor's Workbench Chips

diameter appreciably greater than the weapon's bore. Through its upper side are cut several transverse slots, and a cuplike lip extends across the lower side of the outer end. Effect of the blast, reacting against these, is to push the muzzle down, neutralizing the climbing tendency.

Cuplike Caltrops for Tanks

Another military invention of the week is a device suggestive of the ancient caltrop—a spiky star of iron that used to be scattered in front of defensive positions, to cripple the feet of charging horses or infantry; only the present invention is intended to function against tanks and other tractor-treaded vehicles. It is the invention of William J. McDonald of Kansas City, covered by patent 2,313,388.

The device, which is made of heavy steel sheeting or plating, is a six-pointed star with upcurved arms, suggesting more than anything else the serrated orange-peel cups sometimes used for party salads. Just below the tip of each arm a tough-looking blunt barb projects. The idea is to sow large numbers of these, painted to conceal well in the grass, brush or other local vegetation, over terrain where enemy tanks are expected to appear. When trodden on by the treads, they are calculated to rock on their curved bottoms, jamming their tough, barbed ends into the tracks and crippling the running gear.

Electroplating Magnesium

Magnesium, the light metal that war has brought to the fore along with aluminum, has enormous possibilities in peace as well. But hitherto it has

—SAILS LIKE A DREAM

Ed Williams, of "The Anchorage," Prince Arthur St., Otterburn Park, Quebec, Canada, built this Super Sunray from plans in HOW TO BUILD 20 BOATS. He tells us that she sails like a dream. She certainly looks like a pleasant dream, and she brings her builder a $3.00 Workbench award and a Certificate of Merit.

Editor's Workbench Chips

been impossible to protect with electrically applied platings of other metals, because it gets covered with a coating of oxide in an alkaline electroplating bath, and simply dissolves in an acid one. W. S. Loose of Midland, Mich., has devised a bath containing acids and a chromate, which first etches the surface slightly, then covers it with a protective chromium coating. From here on, electroplating with any desired metal can proceed in the usual way.

Mr. Loose's patent, No. 2,313,756, together with several others on the processing of magnesium issued to him, is assigned to the Dow Chemical Company.

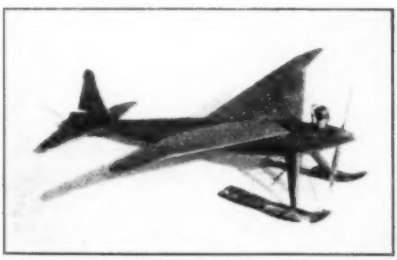
New Papaya Compound

Two chemists of the U. S. Department of Agriculture, E. F. Jansen and Dr. A. K. Balls, have received patent 2,313,875 on a new digestive compound which they call chymopapain, extracted from the tropical fruit, papaya, which has several advantages over the already known papain. They state that it has better clotting qualities when applied to milk, and that it is more resistant to stomach acids when it is desired to encourage protein digestion in the small intestine. They have assigned their patent rights to the people of the United States.

Flax Deseeding Machine

Another patent in which rights are assigned to the U. S. government is No. 2,313,791, issued to Max C. Widger of Corvallis, Ore., on a machine for getting all the seeds out of flax before the stalks are soaked in tanks of water to soften or "ret" them. This retting process, necessary to remove the cortex or bark of the flax, would of course ruin the seed. The flax stalks are passed through a succession of giant combs by a rotating drum, which effectually deseeds them.

MANTA ON SKIS



Charles F. Warren, Clement Dorm. 4, Rensselear Polytechnic Institute, Troy, New York, writes: "Inclosed is a picture of the Manta gas model built from plans in MECHANIX ILLUSTRATED. Skis were used instead of wheels so the model could be flown in the snow. It is powered by a dual ignition Super Cyclone. It flies beautifully at a very fast clip, and can be landed quite easily. Whenever it is flown, quite a crowd of people gather to see it perform."

It isn't surprising that a crowd collects. Mr. Warren also collects—a $3.00 Workbench award and a Certificate of Merit.

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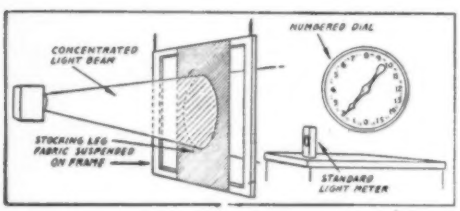
Popular Patents

Instrument Measures Stocking Sheerness

"Glamorometer" might well be an appropriate name for an instrument on which the U. S. Patent Office has issued a patent to Jerome Barney of Bethlehem, Pa. The device measures the relative sheerness of hosiery and similar delicate fabrics. (If you think that's too frivolous a subject to engage the attention of the Patent Office, just ask the ladies—or a hosiery manufacturer.)

Present methods of determining sheerness, the inventor explains, depend either on expert judgment based on visual examination or on measuring and counting threads, numbers of loops, and so on. But even experts' judgments vary, and examination of threads through a magnifying glass is a tedious business.



Mr. Barney obviates these difficulties by projecting a concentrated light beam of known intensity through a layer of stocking-leg fabric suspended on a frame. A standard light-meter on the other side receives the part of the light that passes through, converting it into an electric current that in turn swings a pointer across the face of a numbered dial. Sheerness, presumably, would run on a scale from zero (for thick wool) to practical infinity, for some of the gossamerweb confections that you don't really see, but "just know she wears 'em."

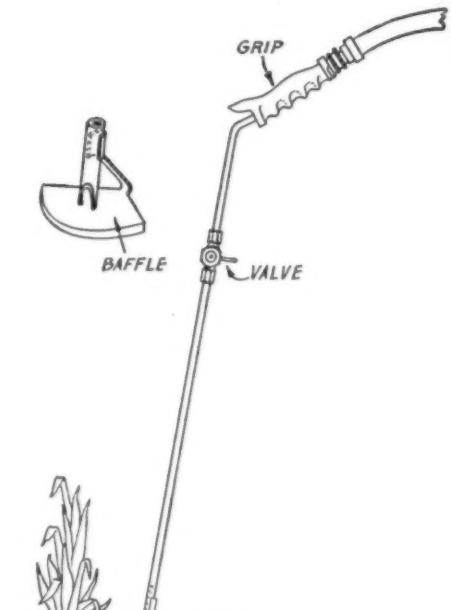
Rights in the patent, No. 3,312,953, are assigned to the R. K. Laros Silk Co., of Bethlehem.

Web For "Human Spider"

The "human fly" who clambers his perilous but confident way over the vertical walls of buildings bids fair to be replaced by a "human spider" safely suspended on a couple of strands of cable, through a tackle invented by Rox D. Penlon of San Francisco, subject of patent 2,312,583. At two widely spaced points on the roof coping the top ends of the tackle are hooked; they converge at the lower ends in attachments on the worker's safety belt. By manipulating their lengths, he is able to shift his position at will to any place on the face of the wall. The device is expected to be useful to painters, window washers, masonry repair men, etc.

Flour Insects Electrically Killed

Again of ultimate domestic interest, though utilitarian rather than esthetic, is the machine for ridding flour of insect pests, on which patent 2,312,368 was granted to Franklin S. Smith of New Haven, Conn. The flour is whirled by centrifugal force in a thin layer over a series of high-tension electrodes, which makes an instant end of weevils, moths, larvae and all other undesirable inhabitants of the flour-bin. Raising of dangerously explosive dust is kept down to a minimum.



To avoid the damage caused by mildew and "burn" which results from the use of certain water on the foliage of plants, Walter Stick and Arthur Stich of Detroit designed a garden sprinkler which waters only the roots of plants. The sprinkler includes a long tube having at its lower end a baffle to convert the water jet into a fan-shaped sheet. The sheet of water can be directed at the lower parts of the plants without wetting the upper parts, and also without wetting the feet or clothing of the user. A control valve on the tube provides control of the amount of water. In use, the sprinkler provides a gentle supply of water that does not loosen the soil. (No. 2,289,889.)

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Win the War at Home

By W. H. FAWCETT, Jr.

President of Mechanix Illustrated

NOW that you've got that Victory garden started, don't let it get you down, except when the time comes to weed it. A lot of things are going to happen to discourage folk who have laid out their first garden. It'll be a good idea to hang a notebook in the tool shed. Then you can jot down the mistakes you make and profit from them next year. Also it can serve to refresh your memory next year when you want to duplicate some outstanding success. Remember the garden won't just grow by itself. You've got to watch it and work it from day to day. Get the kids interested. They can be a big help if you'll take the trouble to show them what to do. They'll likely get a kick out of eating spinach they helped to grow; it will have a different flavor from the store-bought kind. If the neighbor's early chickens do a blitz to your garden, don't give up. Pull out the seed catalogue and check up on what can be planted later in the season. Meanwhile take every precaution to protect your garden. Its success is vital. Don't lay down the hoe—except to pick up the rake.

How about going over to the bookcase some time this evening and digging out a couple of more good books for the boys in the services. While you're about it, also pick out some for the girls because the WAACs and WAVES need them, too. Be sure to remember they want good books. Don't give them a dog-eared old cookbook. They need books about the ideas for which they are fighting; books that will help them get ahead in their branch of the service. Most of all, they need books they will enjoy reading—good fiction, good mystery stories, good biography.

Most of us by natural instinct are talkative. It's typical of the American way of life—a sign of friendliness. But in wartime it is dangerous. It can cost lives of soldiers and sailors. You've seen the posters warning you not to talk. Yet people keep right on talking. Maybe they would curb their tongues if they would just remember the sad story of one ship sinking. "Your ship is several hours behind schedule," the Nazi jeered. The crew knew it was true. The submarine commander knew their orders. Someone had talked.

Learning to save gas means money in your pocket and also aids war industries. If you cook with gas, use one-fourth less. Cook with a blue flame (not yellow), and use less water in the pot. Use your oven as little as possible. When you do, plan to cook whole meals in it. Don't open the door often. Plan more "one-dish" meals. Cook more than one thing in a pot, if possible. Your gas company can tell you many other short cuts. It seems little but it mounts up to a lot.

The Office of Defense Transportation has asked me to pass along to you its suggestions to make a shop-and-carry routine easier. They should be followed the year around. Here they are:

1. Prepare a shopping list in advance. Buy only what you need.

2. Come prepared to carry packages. (Bring along a shopping bag.)

3. Travel during off-peak hours. (10 a.m. to 4 p.m.)

4. Buy lighter articles first; heavier ones later in the day. This saves toting a heavy, bulky bag throughout the day.

5. Buy all articles which *must* be delivered on the same shopping day. This cuts delivery trips from store to home.

W. H. Fawcett, Jr.

FIFTY MINUTES OF HELL

On the map at *lower left* is shown the course of the Battle of Savo Island, in which the Big Bastard —a U. S. battleship whose correct name may not yet be published—and some of her big and little sister ships of the U. S. Navy met and smashed a Japanese fleet in the waters near Guadalcanal, in what is now known as the Fifth Battle of the Solomons. Beginning at midnight of last November 14, the battle lasted 50 minutes. To the men of the Big Bastard, battered but victorious, it seemed more like 50 hours.

SOMEWHERE in the South Pacific [Passed by Navy Censor]—Hodgen Othello Patrick Y1c, talker on the Big Bastard's sky patrol, highest lookout post where the ship took its first hit during the Battle of Savo Island, came as reasonably close to being killed as can be expected of any man.

Patrick remembers squaring for battle and from his high perch seeing the Jap ships come up. He saw the first salvo leave the flagship up ahead.

His next recollection is of being thrown against a bulkhead and finding somebody's arm, without a body, across his face.

by Robert L. Schwartz Y2c

Yank Navy Correspondent

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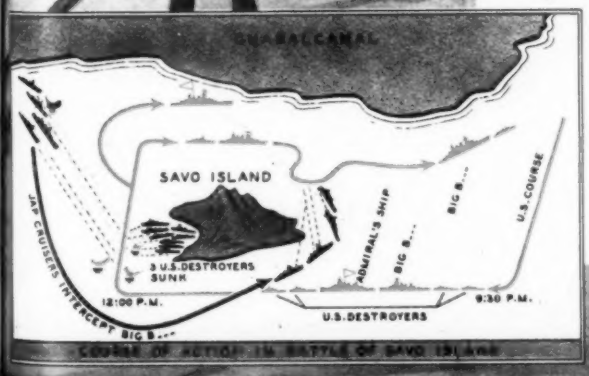
Mechanix Illustrated Art by Fred Ripperda



COURSE OF ACTION IN BATTLE OF SAVO ISLAND

"He took out his knife and walked over to a dangling wire, cut it loose and wrapped it around . . . making a tourniquet."

"I'm dead," he thought, and the remembrance of it is still clear in his mind. "Here I am, dead. This is what it's like to be dead." But the earthly touch of shrapnel in his knee and his hip convinced him that he was still alive. He looked around. The two officers lay dead. Seven enlisted men were still. Four wounded looked at Patrick, not knowing what to do next.

Patrick pressed the button on his headset. "Sick bay," he called, "send help." He doesn't know why he took command. There was another petty officer who not only rated him but was able to struggle to his feet and walk around.

The sound of firing roared up from his own ship. He heard hits coming aboard. But no help came.

Patrick ordered the two least wounded to go below and then put tourniquets on the other two, using their own belts. He applied the same treatment to his own leg above the bleeding knee, then remembered to loosen all three every 15 minutes throughout the night. He hunted a long time for morphine before he found it and divided it with the others. As he was about to take his share of the sedative he noticed that several of the men he had thought dead were stirring. Without a moment's hesitation he divided his share among them. He didn't feel heroic about it. He didn't even think about it.

Despite his injuries, Patrick found that he could get to his feet. He saw that he could report better while standing and remained that way until the end of the battle. Afterward, he fell again to the deck but never stopped his regular reports until he was relieved the next morning.

Patrick was the only enlisted man of the crew who was recommended for the Navy Cross.

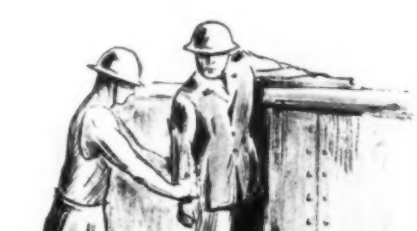
When general quarters sounded on the Big Bastard, Rufus Mathewson Y2c took his post as a talker in the conning tower.

"It'll be a push-over," he heard someone say. "Just a bunch of armed transports. We'll knock 'em off like sitting ducks."

Mathewson said to himself, "I wish I was home." The thought kept running through his head as he watched the captain and the navigator walk calmly back and forth in the narrow steel-walled compartment.

Hours ticked by. Shortly after midnight the loudspeaker carried a cold, steady voice from plot room. "Target 20,000 yards, bearing 240° . . . target 19,800 yards, bearing 241° . . ." Slowly the target drew closer.

There was a terrific explosion up ahead. Mathewson dashed to one of the slits and felt his stomach drop as he saw a battleship ahead silhouetted by flame. "Lord, let me out and I'll change my ways," he said aloud. A



"Another officer came in and said in a strained voice, 'Feel my arm. It's been hit and I can't tell if it's still there. Tell me.'"

Continued

Fifty Minutes of Hell

"Page remembers it was a beautiful night . . . warm and quiet. The smell of gardenias was strong from off Florida Island."

direct hit had dissolved one of the destroyers.

The captain called for a stadimeter reading to determine the distance to the battleship ahead. A lieutenant on the bridge tried unsuccessfully to take a reading through the narrow slot in the armor.

"What kind of a crew have I got when I can't get a stadimeter reading?" the captain asked.

Mathewson felt sorry for the lieutenant. Over the lookout's phone came a voice, "Destroyer sinking on our starboard bow." The captain ordered port rudder, and the helmsman swung the wheel. They skirted the destroyer, then came back on their course. From over the phone came the Admiral's voice: "Fire when ready."

The men on the bridge looked at each other. For a full minute no word came over the amplifier from plot room, then a voice giving the range and bearing. The captain looked at Mathewson. "Tell them they can fire now." Mathewson relayed the command. He could hear compressed air being blown through the 16-inch barrel as the gun crews cleared them before loading. Thirty seconds later shells screamed out. The captain and the navigator were jarred away from their positions at the 'scopes, but voices came in over the phone.

"Right on!"

"The damn thing has dissolved!"

"Looked like a cruiser."

"That was a battleship!"

In rapid succession Mathewson heard a loud crash, a rolling explosion, and then the searing rattle of metal fragments as they crashed into cables, guns and superstructure. The ship shrugged, leaned back into a volley of 6- and 8-inch shells that raked through the sky control tower, topmost position on the ship.

Quickly Mathewson called sky patrol on the battle phone. "Patrick, you there?"

"Here, but our officers are dead, and all of us are wounded."

Mathewson asked for permission to go relieve Patrick but his request was denied. Mathewson and Patrick were close friends, and now the thought of Patrick lying wounded on sky patrol beyond the help of anyone because of fires burning below him almost brought tears to his eyes.

Methodically Big B went on firing.

"Torpedo off the port bow."

"Hard starboard rudder."

The tremendous craft swung over. Everyone strained, bracing for another explosion above the crashing shells and shrapnel. The torpedo missed, but in the confusion following the battleship's evasion tactics she became separated from the other ships and lost her own course.

"If you swing to port you can go back out the way you came in," chart house advised, "but the water's shallow off that way. If you turn to starboard you have to go around the island.

"Starboard," said the captain. And then, as

"A 14-inch shell came screaming out of a gun on a Jap battleship. Buck saw it first when it was about two miles away."

"Buck felt his feet get tangled in something. An officer discovered that his legs were entwined by someone's insides."

a pleasant afterthought, "Full speed ahead."

Six- and 8-inch shell fire peppered the bridge with steel fragments. It was almost impossible for shrapnel to penetrate the armor of the bridge but the men inside heard one shell smack through the gun director just aft the bridge and then explode against the chart house. Directions for course and bearing stopped coming in.

Over the amplifier from chart house came a voice, "My God, this man's bleeding to death. Send help. Hurry. Please hurry."

Melvin McSpadden, the engine control talker, was first to answer. "Sick bay is on this circuit and they'll send a doctor. Give us some bearings."

"This poor guy's bleeding to death. Have you got any bandages? I can't leave him like this."

McSpadden tore down a blackout curtain hanging over one of the slots, stuffed it through the aperture and shouted to a seaman on the catwalk outside, "Take this to the chart house quick."

Another torpedo was sighted and the ship swung sharply to starboard. From all over the ship came the excited voices of talkers. "We're heading for the beach!"

"Why did we make that turn to starboard?" The query came in over McSpadden's phone and he recognized it as that of Batt II, which he had thought abandoned.

He quickly reassured them: "The captain is conning the ship!" That stopped the queries, the torpedo failed to materialize, and the captain swung again to port. The huge ship churned up a massive letter "S" in white-topped water. Some of the waves in the wake were 20 feet high.

Batt II, which is the auxiliary control room situated inside the superstructure below the sky control tower, was the hardest hit portion of the ship. One of the talkers in Batt II was Tom Page S1c of Greensburg, Pa.

Page remembers it was a beautiful night. There was a big moon and it was very warm and quiet. The smell of gardenias was strong from off Florida Island. The association of gardenias with the action that followed caused Page to lose all desire to smell a gardenia again.

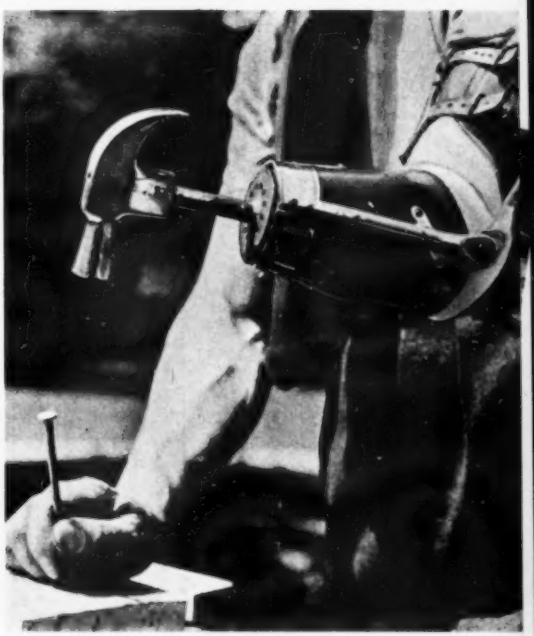
Over the amplifier came a voice, "Guadalcanal on our starboard hand." Big vivid flashes lit the sky—some of it gun fire in the distance, some of it lightning. Everybody in Batt II was tense. Not until the Big Bastard's guns went off did everyone's confidence return. Page went to one of the slots and watched the shells fly through the air like three red dots slowly converging into one, then landing off in the distance. He saw Japs running back and forth on the beach with flashlights.

Page sat in a corner on an overturned bucket, feeling [*Continued on page* 160]

"Below decks, in engine control room, Chief Yeoman Cheek was quietly reading."

WONDER ARM

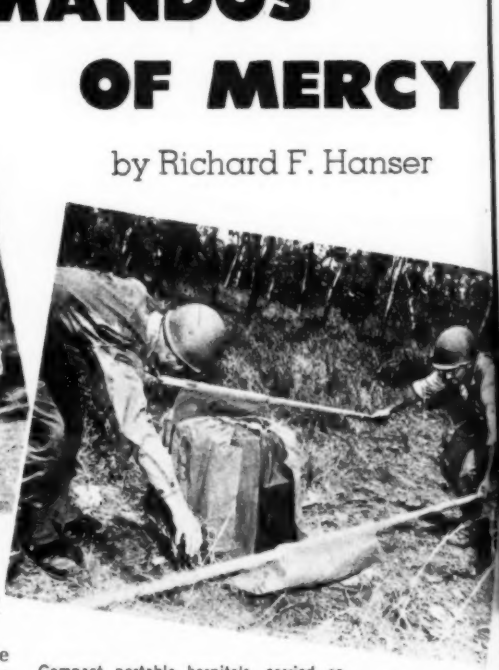
CIVILIANS in England who have lost legs or arms need no longer be shut off from useful work or from participation in sports. With the aid of the marvelous new artificial limbs now being made available by the government, persons with only one natural arm can handle tools fully as well as most people with two arms. Pictured on this page is Capt. A. R. Maxwell, a technical adviser to the British Ministry of Pensions, demonstrating his machinemade arm and a few of its many attachments. At *right*, the arm's flexible tube and golf-club grip; *lower left*, a metal hand fits on the end of the arm, its fingers opening and closing as a small wrench adjusts them; *below right*, the hand becomes a hammer. Arms like this are sold at cost by the Ministry of Pensions to civilians who can afford to pay for them, are supplied free to those who cannot.



COMMANDOS OF MERCY

by Richard F. Hanser

Medical units in this war work near the front, ready to give wounded attention quickly.



Compact portable hospitals, carried on slings, provide care for emergencies.

AT PEARL HARBOR, on the day when the United States Navy suffered the most staggering and disastrous blow in its history, when the Army Air Forces stationed at Hickam Field were virtually smashed to bits before they could even get their planes off the ground, one group of American fighting men scored one of the great victories of this war.

Since then, these men and their comrades have fought on every front. They fought on Bataan and Corregidor, they are fighting now in Africa and in the Solomons and New Guinea, in China and in Iceland, in England and in Washington. They fight sometimes on foot, often in jeeps or planes, on battleships and in submarines. And the brilliant record they made on "the day which will live in infamy" has not only been sustained, but even bettered.

They are the men and women of the services' Medical Corps. Unarmed, except for their weapons against injury and pain, they share all the dangers of front-line action. Casualties among them are often high. But because of them the fatalities and permanent disabilities of our fighting men in this war have been cut to a point which, compared with any other war ever fought, seems incredible.

In World War I, for example, 80 per cent of soldiers suffering severe abdominal wounds died. In this war, 80 per cent of soldiers suffering such wounds are saved. In World War I, of every seven men suffering compound fractures, infection killed one; in this war, the proportion is one fatality out of 200. In World War I, a man's chance of recovering from an infected fracture with a useful limb was fifty-fifty; in this war, his chances are nine to one in favor. In this war, the Navy recently announced a new world's record: of 4,000 land, sea and air casualties treated in the South Pacific and Australia by its Medical Corps, only seven died!

How was this miracle done? New techniques of surgery and healing are partly responsible. The amazing and versatile sulfa family of drugs have proved invaluable; new anaesthetics and new methods of anaesthesia have made possible vital operations which a few years ago could not have been even attempted; blood plasma is the greatest weapon known against shock. But the most effective weapon of all in the battle against death is speed.

In the First World War, casualties were usually sent far to the rear before receiving anything but the most rudimentary first aid treatment. By the time they arrived where adequate facilities were available, shock, loss of blood and infection had too often done their death-dealing work.

Today plasma, sulfa drugs, local anaesthetics and immediate treatment are administered with such speed and effectiveness that by the time the casualty starts his trip to the rear the worst of his ordeal is often past and he is already well on his way to recovery.

Portable hospital, set up and ready, contains everything necessary for life-saving first aid.

To achieve this, the whole medical corps has been streamlined for the utmost speed in treatment, which means that the medics have to be in the front lines—which means in turn that medical corpsmen, though they cannot fight, have to be where the fighting is thickest.

Organization and efficiency in the corps have reached such a pitch that in the Buna campaign a wounded soldier usually received treatment within ten minutes after being hit and often was undergoing a major operation within a half hour.

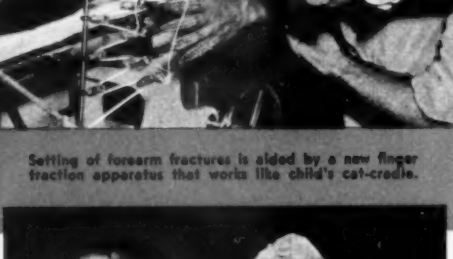
Each platoon had attached to it a medical corps man who went into battle right alongside the combat soldiers. So that this man would not have to be burdened and hampered by a load of bulky supplies, each combat soldier carried on his cartridge belt a small first aid pouch. This contained sterile bandages, sulfanilamide tablets, a shaker full of sulfanilamide powder and a syrette of morphine. The syrette contained half a grain—twice as much as the World War I "Greeley units" held—ready in a small hypodermic in a sterile wrapping for instant injection.

Private Joe Smith, say, was crawling through the New Guinea underbrush when a Jap bullet smashed into his leg and brought him down. Swiftly a medical corps man bends over him, cuts away the trousers around the wound to expose it. A glance tells him that Smith's leg has a compound fracture and, like all battle wounds, this one is full of dirt. In a matter of seconds the

Field hospitals for operations and emergency care beyond first aid work just back of the lines.

Wounded needing more than field hospital care are flown back to fully-equipped base hospitals.

Setting of forearm fractures is aided by a new finger traction apparatus that works like child's cat-cradle.



On a Navy hospital ship a large magnet is used to extract metal fragments, without surgical cutting, from injured eyes.

medic has given Smith a shot of morphine to kill the pain, dusted sulfanilamide powder into the open wound, covered it with sterile bandage, and signaled for the litter bearers.

About 300 yards back of where he fell, Smith arrives on a litter at a casualty first aid station. Here two doctors, assisted by trained enlisted men, are waiting. Smith is suffering from shock, which, though it isn't serious in his case, might become so if not treated promptly. He's lost some blood, too. Promptly he is given a transfusion of blood plasma; he gets a quick, expert checkover, and sets out on the litter again for the portable hospital, about 800 yards farther back.

Here are surgeons, with full equipment. A small, modern X-ray gives them in a few minutes a picture of the inside of Smith's leg. The patient is given an injection of a new anaesthetic, pentothal sodium, and skillful hands set his broken leg. Splints hold it in place while a plaster cast is put over it, and Private Smith is ready for the air ambulance which will fly him back to a base hospital.

Because of the new anaesthetic, Private Smith will not have to wait long hours before being able to make the trip back to the base, for pentothal sodium has almost no after-effect at all. Post-operative shock, in all except the most difficult cases, is a thing of the past.

That plaster cast will not be taken off Smith's leg, no dressings will be changed, for about six weeks. With the cast left on, his leg will cease to give him pain in a day or so, and the chances of its becoming infected are almost zero. This is the "closed treatment" for wounds, developed by Dr. H. W. Orr of Lincoln, Neb., and tested widely during the Spanish Civil War by Dr. Jose Trueta Raspall of Barcelona. Of 50,000 cases treated by the Orr-Trueta "closed" method during that war, the fatalities were eight-tenths of one per cent. In six weeks Private Smith's cast will come off and expose a leg completely healed.

For other types of injury, other new methods come to the rescue. For simple fractures, for example, in which the danger of infection is very small and the surgeon's main task is to hold the broken bone in place while it knits, the old plaster cast has been supplanted by the Stader splint. First used on animals, this splint consists of a metal rod fixed to two metal pins driven through the affected bone on either side of the break. The bulky, clumsy cast is eliminated, and the arm or leg, held firm by the strong bar, can actually be used while it is still knitting, for the muscles and tendons are not held rigid as a cast would hold them. With a Stader splint, it is commonplace for a man with a broken leg to be walking around

Continued

Commandos of Mercy

quite comfortably, without crutches, as little as two or three days after his leg has been set.

In the treatment of burns—a problem with which the Navy Medical Corps is especially concerned—proper use of the sulfa drugs has effected cures which a few years ago would have been considered no less than miraculous. Sulfanilamide has been used as a powder; it is effective, but tends to cake. Better practice is to dissolve it in mineral oil. But best of all is sulfadiazine dissolved in triethanolamine—sprayed on, this treatment relieves pain, requires no dressing of the burns. Combined with plasma transfusions to combat shock, which invariably accompanies severe burns, it has restored to unmarred health many a man who could not otherwise have been saved.

Anaesthesia, the blotting out of pain, has made amazing advances. Ether and chloroform have given way largely to intravenous injections—a squirt of a drug like procaine immediately brings a blessed surcease from agony and allows the surgeon to do his work while having no adverse effect on the patient. Fear of an operation can so alter the victim's physical resistance that an operation may become extremely dangerous or even impossible. Today a drug called avertin is often administered before the regular anaesthetic; it is called avertin because it "averts" fear. The patient's tensed muscles relax, permitting the surgeon to proceed unhampered. It is possible today, further, to give "nerve-block" injections which free specified parts of the body from pain without affecting the others.

Every battle front requires its own medical setup. In North Africa, where the action is extremely mobile, medical units must be able to follow the troops with the same speed as other mechanized units. For this purpose mobile operating rooms and laboratories have been designed. Light field ambulances, with four-wheel drive, will go almost anywhere a tank can go. They are equipped with springs which take up shocks and eliminate lurching. These ambulances will carry seven sitting or four litter patients in a single trip.

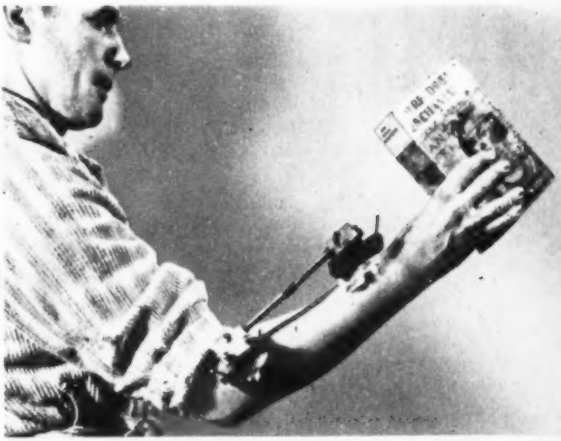
Battalion aid stations in North Africa are often less than 1,000 yards from the front. They consist of armored half-tracks with Red Cross markings on top and sides. Operating units are ordinary two-and-a-half ton trucks in which small but excellently equipped operating rooms are set up. Casualties are carried directly from the field to the trucks where doctors are prepared to do everything from dressing a leg wound to removing splinters from the brain.

Each truck has lights and stretcher racks on each side so that three operations can be performed from it simultaneously. Capt. Armand Devittorio of Ridgeway, Pa., reports that on one occasion his unit worked 13 hours on end and handled 57 operations on two trucks.

In other sectors, blackout tents permit operations to continue all night. While most of the operation posts are beyond the range of artillery fire, they are always within easy bombing range of [*Continued on page* 150]

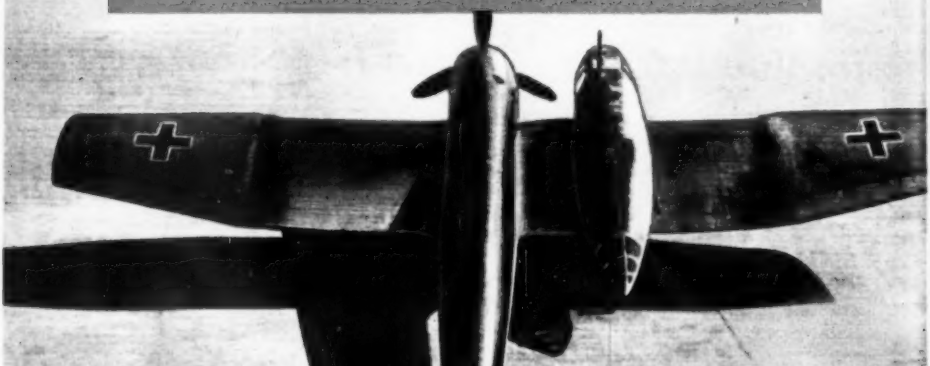
Photo by Life Magazine

Exercise devices in great base hospitals help men regain full use of wounded limbs.



With the new Stader splint a man with a broken arm needs no cast, can retain use of his fingers throughout period of healing.

WHY LOP-SIDED AIRPLANES?



Probably the best-known asymmetrical airplane is the Blohm and Voss 141-B, *above*, news of which was published in Germany last year. Germans have been working on planes like this for many years.

by Willy Ley

WHEN the first photographs of the "lop-sided" German Blohm & Voss 141-B were released by German censors a few months ago, most commentators wondered just what that design was supposed to accomplish. And almost without exception the prevailing opinion was that this Blohm & Voss plane was an entirely new "stunt." Actually there are several good reasons for testing such a construction, nor is the conception of an asymmetrical airplane very new.

As a matter of fact the very first airplanes that flew, those of the Wright Brothers, were mildly asymmetrical. Pilot and engine were placed side by side instead of in line as became the custom soon after. Even the Fokker F-1 was mildly lop-sided in precisely the same manner, Fokker also placed pilot and engine side by side.

The main reason why it became the general practice later on to place either the pilot behind the engine or the engine behind the pilot was based on considerations of air resistance. Being in line, pilot and engine offered hardly more air resistance than each one separately.

This was a more or less permanent solution as far as single-engined planes went, but when later constructions began to employ more than one engine the problem came up again. Professor Hugo Junkers, the creator of the German Junkers Airplane Works, never planned a twin-engined aircraft in his life (he died just after Hitler came to power), but designed three-engined aircraft if one engine could not do the work. It was his opinion that the air resistance offered by the cabin should not be "wasted," but might as well be utilized to squeeze another engine in.

Other designers, however, were toying with the idea of asymmetrical planes for other reasons. They thought mainly about military planes, fighter craft, and sought to improve upon the World War models. Most fighter craft during the first World War had been of the single-engined type, with the machine gun or machine guns firing through the propeller by means of a synchronizing gear. For some reason everybody was very proud of that synchronizing gear, although it actually was a step in the wrong direction. Not only was it very heavy, using up payload capacity which would have been better allotted to

Front view of the Blohm and Voss 141-B, taken during its testing in Germany in 1942. Note pilot's wide, unobstructed vision.

Rear view of the BV 141-B. Though the late Ernst Udet, of the Luftwaffe was interested, these have not been mass-produced.

more ammunition or more fuel, but it also retarded the rate of fire from the machine guns. That rate of fire could have been in the neighborhood of 600-700 rounds a minute; it was forced down to about 200 rounds a minute by the gear.

There were several solutions to this problem, almost all of which are now embodied in one or another present-day fighter design. One solution was to fire through the hollow propeller hub; that is the design of the Airacobra. Another was to place the guns in the wings outside of the propeller circles; that is the way most fighters of today are built. The third one consisted of having the machine guns in the cockpit and the engines in nacelles: The design of the Lockheed Lightning.

And then there was another possibility: engine nacelles and the machine-gun carrying fuselage section could be separated as shown in the drawing at the bottom of this page. This design sketch is taken from one of five German patents granted to the firm of Gothaer Waggonfabrik during the interval from about 1917 to about 1920. Its inventor is the Swiss engineer H. Burkhard, who was then employed as Chief Designer by that German firm. As the sketch shows, the airplane was a two-engine type. One engine was situated in front of the fuselage in the ordinary manner, with a machine-gun mount in the same fuselage behind the wing. The second engine was placed in a nacelle to the right of the fuselage, operating a pusher propeller so that the machine gunner in the nacelle had clear view and a clear field of fire forward.

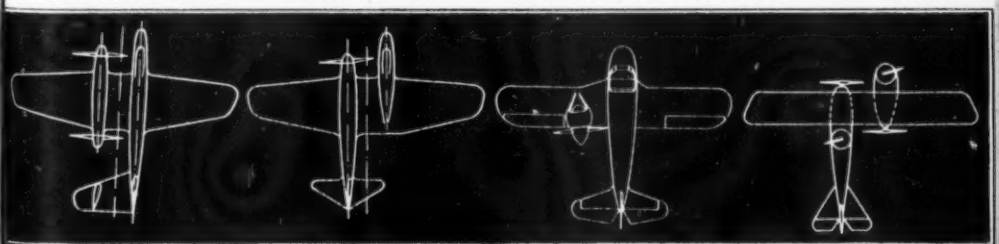
This type, designated as the *Go. G. VI.* by the factory, was actually built in 1918 and testflown for several weeks. It seems that only the Armistice kept it from being adopted by and manufactured for the Kaiser's air squadrons.

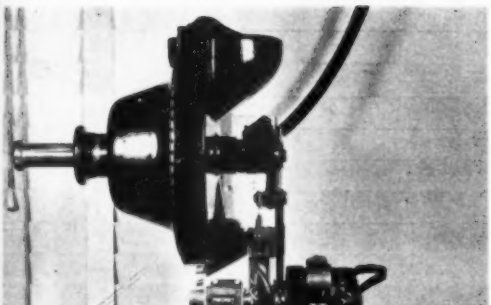
It is quite likely that many designs of this general type were drawn up during the 10 years following the first World War, but only a few of them became known, mostly from patent applications.

As far as is known no asymmetrical design has been built commercially. The second design of this kind to be testflown was the Blohm & Voss 141-B, based on patents granted to its designer, Dr. Richard Vogt, Chief Designer of the Airplanes Section of the Blohm & Voss works.

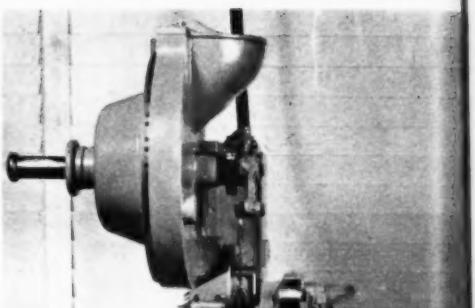
Dr. Vogt recently published an article in a German magazine in which he revealed that he had succeeded in interesting the late Ernst Udet, engineering chief of the Luftwaffe, in this innovation and that Udet exerted all his authority and influence to get such a plane built. Actually the first plane was ordered in 1937 and finished in 1938. Its engine was an air-cooled radial B.M.W. (Bayerische Motoren Werke) [*Continued on page* 150]

Four patent drawings of asymmetrical airplanes are shown *below*. *Left to right:* H. Burkhard's 1917 design for the German firm of Gothaer Waggonfabrik; an American patent issued to T. P. Wright in 1933; two German patents issued to Dr. Richard Vogt.





Punch-press pictured above in usual dull paint presents no clear focal point for operator's eye, is extremely hazardous.



Same punch-press with modernized paint job. Note absence of glare, how working points stand out against light shield.

RAINBOW MAN

by James Blake

Faber Birren has kept his eye on the rainbow—and found a pot of gold in color engineering

HE'S a scholarly-looking man who has—quite literally—found a pot of gold at the end of the rainbow. He's Faber Birren of New York, who has parlayed an idea and the three primary colors into a new science.

It's the science of color engineering, consisting of one part physiological optics, two parts psychology, a dash of art and just a soupcon of chemistry. Mix well, apply in generous doses and the result is boosting the health, morale and efficiency of the men and women turning out the tools of war in the nation's factories.

The illusions Birren is shattering are as numerous as the new vistas he is opening. "Men in White," for instance, is well on its way to the limbo of forgotten phrases in this country as Birren and his portfolio march in and out of the nation's hospitals. He's doing it with his little spectrum.

White walls and white garb in operating rooms, he noticed, cause a glare which tires surgeons' eyes rapidly during periods of concentration under bright lights. White, though efficient in light reflection, causes the pupil of the eye to contract to accommodate itself to the level of brightness of the entire room. So an eye adapted to brightly illuminated white walls is hardly in the right condition for delicate anatomical work.

Therefore out went the white smocks and masks and in came the tailors and painters. Walls, doctors and nurses were outfitted in tasteful blue-green. Fatigue from eye-strain

plummeted the first time the new hues were tried.

From the hospitals Birren marched to the restaurants. Hit by meat rationing, a cafeteria was trying to boost its salads but found the customers unenthusiastic. Birren suggested serving them on green plates instead of white, creating the illusion of larger and greener salads. The crockery was switched and in a week salad sales doubled.

Last year meat was plentiful, but officials of a large Chicago packing house were holding nervous confabs about the steady decline in their business. Birren showed up with his portable rainbow and got a swift attack of nausea at his first glimpse of the display rooms.

His color-sharpened eyes saw at once that the yellow sawdust on the floors cast a bluish tinge on the beef. And the impact of the white walls on the eye created a gray after-image, robbing the meat of its rich, natural redness. The whole thing was distinctly unappetizing.

But it was easy to fix. The walls became blue-green to create a contrasting after-image highlighting the red meat; the yellow sawdust was swept out and blue sprinkled about. The gray film disappeared at once. Up went the sales of meat.

Then came the factories. A Connecticut manufacturer wailed to Birren that the women in his plant were deserting their jobs just as they became trained to peak efficiency and that the absentee rate was rising as rapidly as his blood pressure. Birren hopped a train for a tour of inspection.

He found the working floor of the factory one ugly sea of dark hues—black machines, dark gray walls, black hampers strewn about. The plant itself looked cold and vaulty. Birren shuddered and went to work.

He proceeded to paint the interior a warm buff to get around the forbiddingly cold appearance. Good visibility requires contrast, so the machines became a soft gray. To eliminate all possibility of monotony, posts standing about 30 feet apart were painted a light blue. The rest rooms were redecorated in pastel tones and were lamplit to make them relaxing and feminine. The cafeterias were brightly illuminated and tastefully decorated.

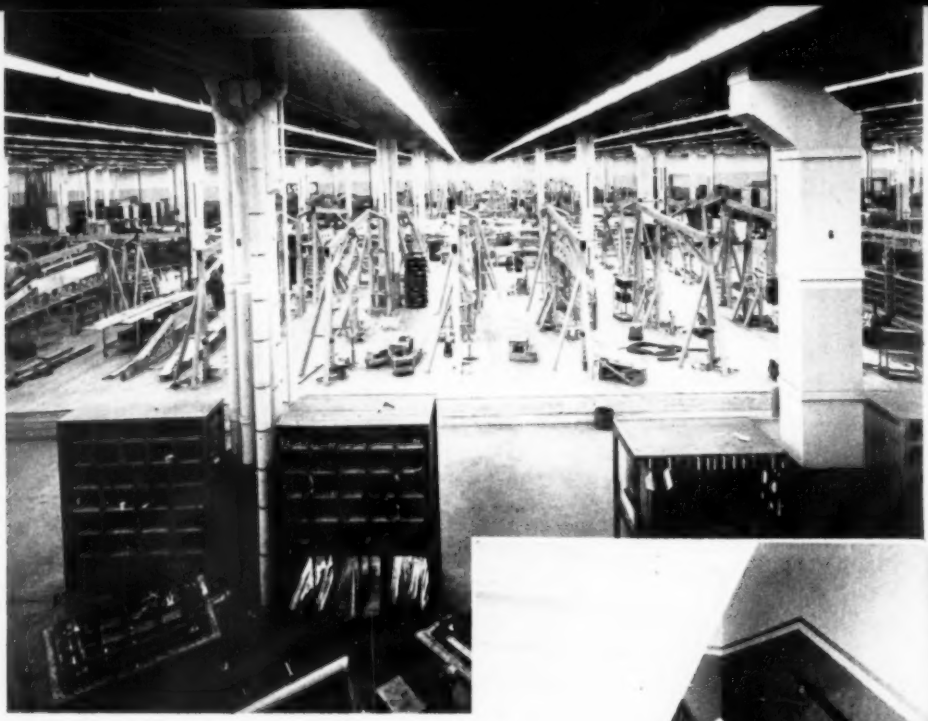
Absences ceased almost at once and the output rose 10 per cent as the women tackled their machines with renewed vigor.

There are many strange inter-relations the color-engineer has discovered, between ease of seeing and the functioning of the human body. General nervousness, increased muscular tension, more rapid blinking of the eyelids, decreased heart action, headache and fatigue are all likely to be found wherever there is eye-strain.

And what causes eye-strain? Blame these: insufficient illumination, glare, prolonged

White disks on black table, above, stand out clearly but sharp contrast will seriously strain eyes subjected to it for long periods.

White disks against gray background are easily seen without glare, do not require eyes continually to adjust to sharp color differences.

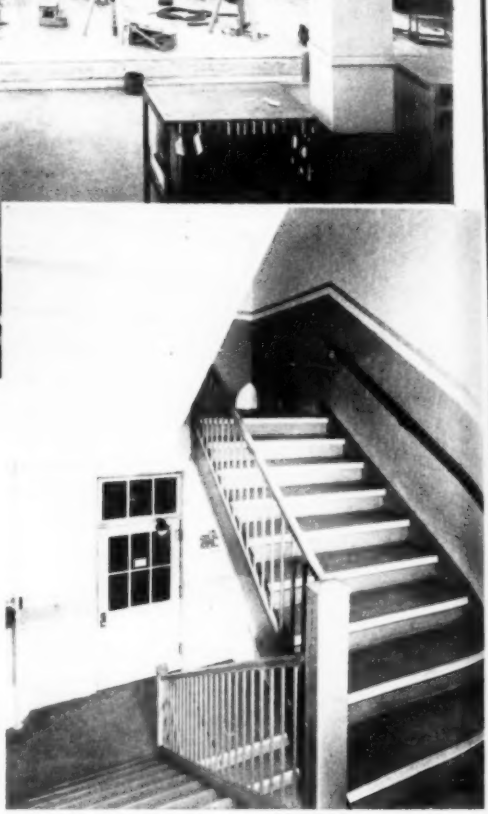


In the plant pictured above, where airplane wings are made, the problem was to get good light, cut glare from aluminum. Solution: three shades of gray, dashes of blue and yellow.

convergence of the eyes, distractions caused by bright areas on the boundaries of vision, continual pupillary adjustments, quick changes from light to dark, wrong contrasts between work and surrounding areas.

Birren finds the cause and paints it out. Just as he painted out the trouble of the woman executive who worked in an elegant office in one of the spires at Radio City in New York, but who came down nonetheless with a severe case of eye-strain. Her office was on the 62d floor and the sun poured gleefully into the room, playing hop-scotch around the ivory walls and black desks. The contrasts were terrific. When the woman glanced up from her work the pupils of her eyes contracted almost immediately and wouldn't open sufficiently for some moments after she went back to work.

The color engineer had to make the point of concentration brighter than the surroundings. He painted the walls a blue-green and the furniture a lighter shade, creating an even balance. No more eye-strain.



Factory stairways, frequently scenes of accidents, can be made safer by white paint on backs of steps, clearly marked stepnoses and rails. White corners encourage cleanliness.

Faber Birren knew ever since he was in short pants that somehow or other he would wind up in the color business. Color affected him right from the start. When he was a boy his mother bought him a summer cap with a piece of blue celluloid fastened inside the

Continued
RAINBOW MAN

brim. He didn't know why, but he was certain that with the strip of blue resting against his brow he'd be quite immune to heat prostration. When he had the croup nothing but red flannel could possibly serve as a bandage to conquer the affliction. And nothing but white stockings could keep his feet free of corns and bunions.

Years have passed and he realizes that his strong feelings on those matters were not empty superstitions but definite sensations based on emotional responses to color.

But this tall, sandy-haired, be-spectacled man almost missed out on this most unusual of businesses. His father, a landscape painter, had his heart set on having his son follow in his artistic footsteps, and from the age of ten young Faber dutifully studied art. He changed his mind one winter at the University of Chicago, where he wandered into a course on color harmony. From then on he knew what he wanted.

Walk into Birren's offices in New York and you get the very definite idea almost at once that the business transacted therein is, to say the least, different. The walls of the reception room are of a medium blue with indirect illumination to create a dignified atmosphere. Turn right and walk down a coral-colored corridor, painted to simulate sunlight since the hall is not ordinarily exposed to daylight, and you'll find Birren seated behind a desk in an office of soft gray and blue tones. Immediately you are struck by highly colored exhibits on the walls, exhibits of the various jobs Birren has completed. And that's exactly what he wants . . . the blue and gray walls cause the pictures literally to leap out at you.

Improving morale and increasing production is just a part of Birren's job. He also spreads his pigments at strategic spots to lower accident rates in factories.

In Indiana a punch-press machine accounted for an average of six severely punctured hands each month before the bosses decided to try color as a remedy. The machine itself presented a series of sharp color contrasts which caused eye-strain and poor visibility. Since the important areas of concentration were not highlighted, the operators found considerable difficulty in localizing work, and the swiftly-moving point of the puncher descended often and painfully on their hands.

Solution: Three different colors were used to set off the important parts of the press: light gray, dark gray and silver. Since one color isolated the machine and another the job itself, the operator was able to see exactly what he had to do. Result: Six months went by without a single accident.

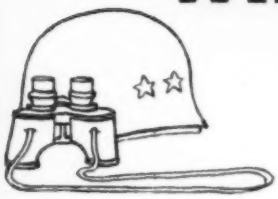
Most accidents in factories, strangely enough, occur on stairs, when hundreds of workers jostle down at the close of the day. Color splashes to the rescue. The edges and bottoms of

[*Continued on page* 143]

Modern operating rooms have abandoned the traditional white, are painted blue-green or some other more restful light-absorbing color.

Faber Birren, who puts the rainbow to work in everything from hospitals to factories.

WHAT IS A BATTLE?



by Major Malcolm Wheeler-Nicholson

How is a battle planned? Why does the Commanding Officer give each order? How is a victory won?

VICTORY in battle stems nine-tenths from planning and only one-tenth from actual fighting. The skilled general has usually won his battle before a shot is fired. The more skilled he is the more does he rely upon a few simple rules of warfare.

War itself is essentially a simple and primitive activity. Only military pedants and desk soldiers tend to complicate it. By proper use of the few basic rules that govern its effective prosecution, the skilled general can usually win over greatly superior numbers.

The few basic rules of warfare are known as the principles of war. They are as ancient as war itself. Battle *tactics*, i.e., the employment of troops directly in physical combat against the enemy, change with every generation and with every improvement in weapons. But the principles of war, the rules of *strategy*, are the same with aircraft and mechanized forces in Tunisia today, as they were when the first cave men banded together to battle the plug uglies under Og, across the valley thousands of years ago.

There are nine of these rules of *strategy*, each of them absolutely essential to the speedy winning of victory.

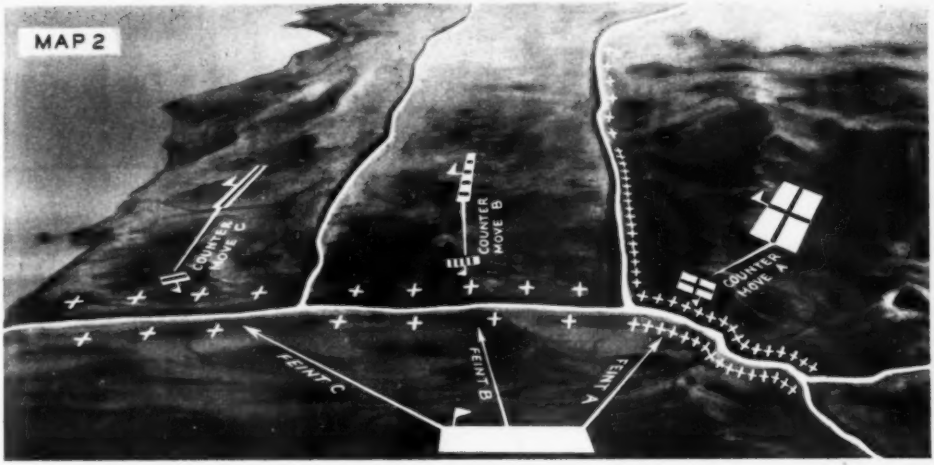
If we want to understand the news dispatches from the battlefronts in our newspapers each day, we must first understand these basic principles of warfare. Let us, then, construct an imaginary war and see how it gets under way and then follow it through, step by step, to the final victory.

We will first construct the basic *strategy* of our imaginary war. Then, when all the preparations are completed, we will move into the field with the commanding officer of our imaginary army and actually fight his battle with him—as he applies his *tactics* against the enemy.

The nine basic rules of *strategy* can be grouped into three stages: 1. The Preparatory Stage; 2. The Initial Move Stage, and, 3. The Final Stage.

Taking them in order, their application in each stage is illustrated on the maps—using imaginary countries, one of which, designated as the Red Nation, plans aggression against its neighbors—the Blue, Green and Orange nations.

Map 1 shows the grouping of these four nations—with the aggressor nation, the Reds, maintaining an army of 3,000,000 men against

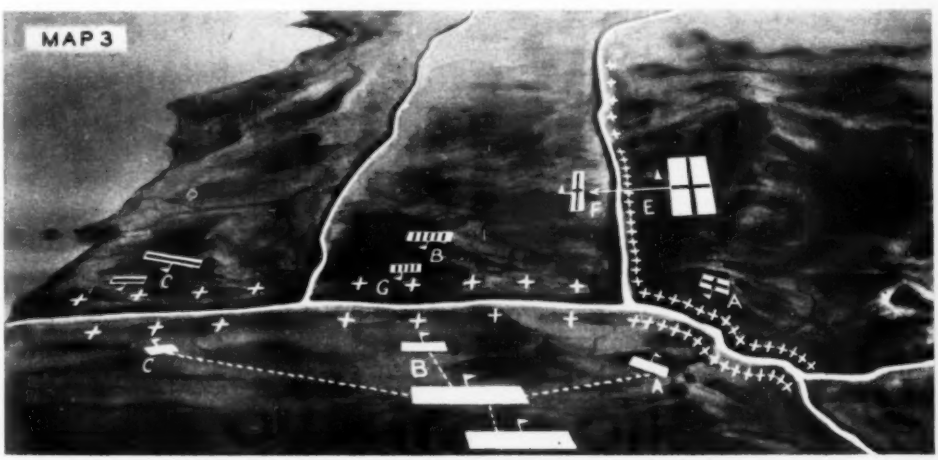


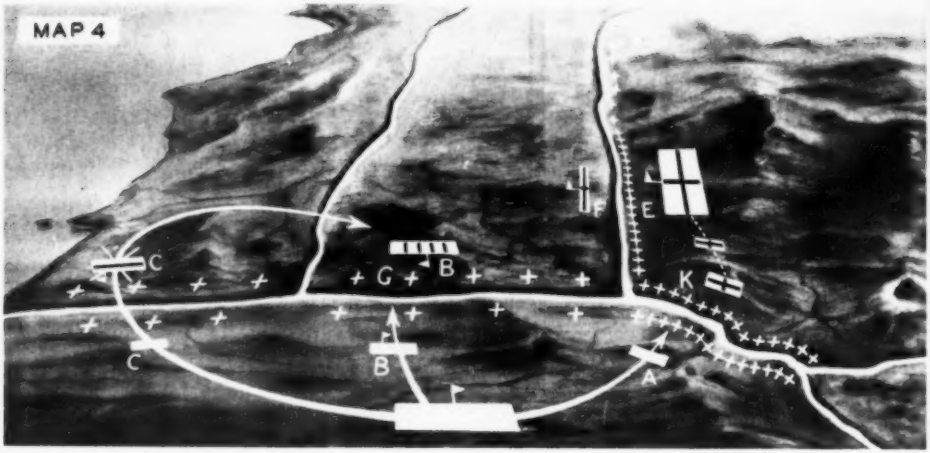
forces of twice its strength—the Blue army of 4,000,000, plus the allied Green and Orange nations, each possessing an army of 1,000,000.

We assume that the three allies are mobilized against the threatening attitude of the Red nation. It is obvious that the initial advantage lies with the Red forces, despite their numerical inferiority. They are the aggressors and can plan in advance where and when to strike, whereas the allies must wait and attempt to guard all points against threatened attack.

The Red army uses the first group of principles in planning the preparatory stage of its campaign. The first of these principles is absolute (1) *unity of command*—with one commander and one will directing the planning and the operations, to ensure the maximum of (2) *co-operation* between the various services. With these necessities acquired by proper organization and peace time training, the first step in planning is the determination of (3) the *main objective*. Most civilians and too many generals confuse the main objective, too often believing it to be the seizure of enemy territory or cities. It is not—the main objective in war is the destruction of the enemy armed forces. These once destroyed, territories and cities fall automatically.

It does not necessarily follow that all the enemy forces have to be destroyed—the smaller forces will collapse if the enemy's main strength is scattered. In this case the main enemy strength consists of the 4,000,000 men in the Blue army and air force. The



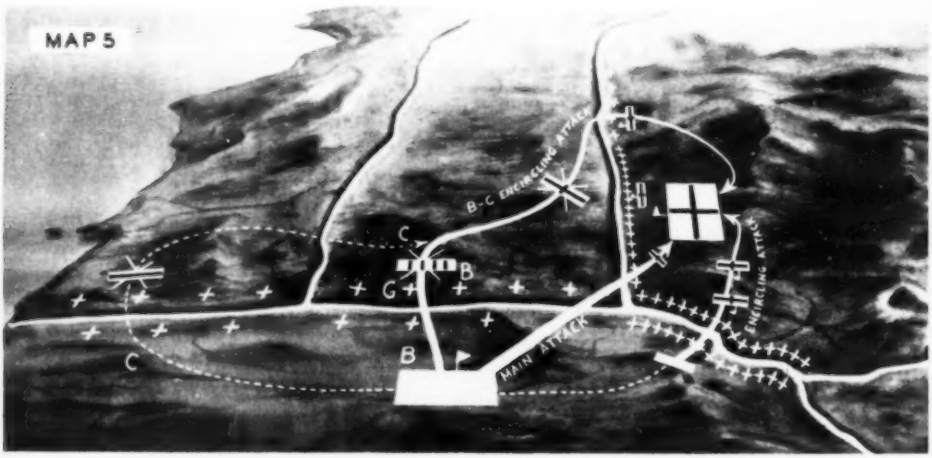


destruction of that force is then the *main objective* of the Red force.

But to destroy that Blue army, the Red forces must have freedom of action to use all their forces without danger of counter attack. This involves use of the principle of (4) *security*. Security is the dynamic type of defense, best illustrated by the advance guard and flanking units which protect an advancing army. In this case, study of the map will disclose that the Red forces have provided some of that security with the fewest possible troops by heavily fortifying their border against the Blue nation. Their main *security* is provided by their planned attack, on the axiom that the best defense is a strong attack.

Now with those four great principles of war, i.e., *unity of command, co-operation,* the *main objective* and *security,* actively in use, the Red army plans the second stage—that of the initial movement.

Obviously the Red army is heavily outnumbered. But it can overcome this disparity with proper handling of its inferior strength by using the principle of (5) *economy of force*. This principle simply requires that the smallest force adequate to the purpose shall be dispersed against minor objectives in order to retain the largest possible forces for use against the main objective. This permits the use of the next great principle, the principle of (6) *concentration*, against the main objective. The Red army has economized men by use of fortifications and probably has less than half a million men

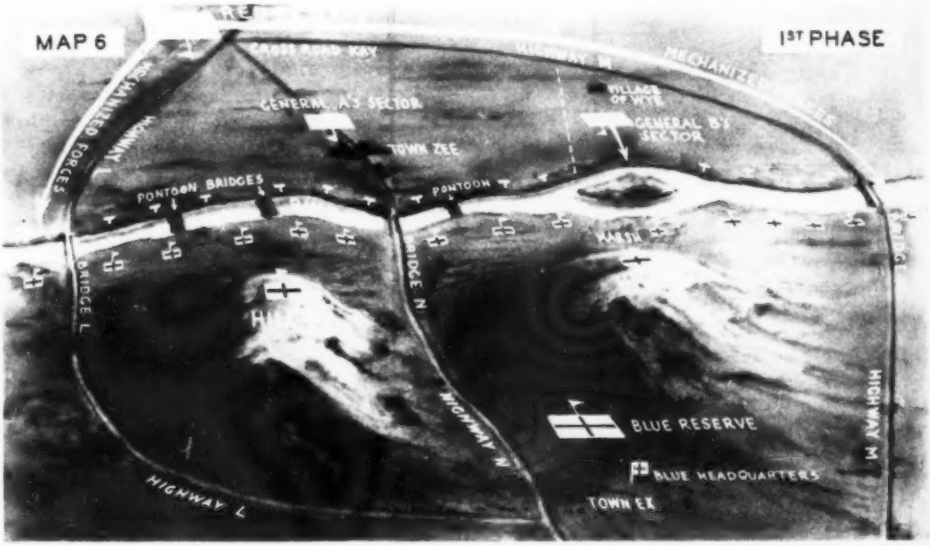


along its borders, thus retaining 2½ million for a compact striking force which permits it to follow the next great principle of war, the principle of (7) the *offensive*.

But economy of force goes farther than this. It requires not only that one's own forces be concentrated but also that the enemy's forces be dispersed in accordance with the old Roman rule of "divide and conquer."

Map 2 shows the preliminary steps in accomplishing this. The Red army makes three successive feints, shown as A, B and C on the map. These feints are aimed at different portions of the enemy lines and result in counter moves by the three enemy armies, by the Blue forces behind the lines. The main Blue forces in counter move E move toward Point F on the Blue-Orange border with advance detachments crossing the border at F obviously to concentrate with the Orange forces, for attack through the weaker part of the Red border at "G." Map 3 shows this situation.

This is fair proof of Blue intentions but not enough. The Red commander, to test it out and prove the point, relieves the pressure of his forces at "B," makes a stronger feint at "A" and then when the Blue forces halt and withdraw to meet this new threat, he mobilizes strong forces again at "B." Again the Blue forces swallow the bait. Again



each of which moves troops to the threatened points. Thus the Red army secures dispersion of the enemy, for all the allies have moved heavy forces up to their frontiers, by counter-moves A, B and C, instead of combining their forces in a single overwhelming mass.

But the allied plan of defense, which is probably based upon some sort of an attack upon the threatening Red forces at some predetermined point, has not yet been disclosed. The Red commander must know this in order —as in jiu-jitsu—to use the opponent's own moves to overthrow him.

Intelligence reports from air reconnaissance and spies report a second and greater move they move toward the Orange-Blue border through point "F." The Red commander now is certain of the enemy plan of attack. He puts his forces in motion to take advantage of it.

To take proper advantage of it he employs the final two great principles of war—the principle of (8) *mobility* and the principle of (9) *surprise*.

He uses the principle of mobility by hurrying fast mechanized forces against the Green army at "C," simultaneously with the smashing forward of a prong at the Orange forces "B" through "G." At the same time he feints attack "A" against the heavy Blue fortified line. See Map 4. [*Continued on page* 154]

A MOTORLESS VACATION FOR YOU

by J. A. Emmett

Sunset over a northern lake looks down on two canoeists whose vacation travel plans bypass rationed tires and scarce gasoline.

YOU haven't set the alarm; so by the time you wake up you know that the boys in the shop where you work have had their sleeves rolled up for a good half-hour, but it doesn't worry you. You even enjoy it, and roll over for another little while, smiling. For this is the opening day of your vacation.

Later in the morning, as you do your packing, you smile again. You remember that one of the boys had his vacation a short time before you; he just went to some little place right near town and stayed there—it was as far as his gas would take him. You're not worried about that; you're not going to use your car at all. Another fellow's been wanting to go to one of the big resorts; it turned out that the Army was occupying all the main

An open fire and a canvas shelter rigged on sturdy boughs make any convenient campsite home for a night in the woods.

hotels there, and the rest had either closed down or were booked up weeks ahead. Tough on him, but you're not up against anything like that.

As you finish your packing, you're feeling even better. This is one year when neither you nor your wife needs any new vacation clothes; most of your good clothes, in fact, you're not even taking along. Those suitcases are full of the tough old clothes you've been using for years on your fishing trips.

By the time you set out for the railroad station, you're nearly as excited as the kids. For this year you're taking a new kind of vacation—one you've often dreamed of taking, but never got around to before, to places you'll be exploring for the first time. You're going canoe-camping.

You have no special equipment, no experience at this sort of trip. But those things don't worry you at all.

Throughout our northwoods and in Canada firms located at strategic points make a business of catering to canoe parties. Most of them were operating back in the days when cars were unknown; so their posts are located with rail transportation in mind. And trains into such isolated sections are never crowded. You can rent everything required with the exception, of course, of clothing and personal things: the canoe, tent, sleeping outfits, cooking gear, and even food in sections where supplies cannot be replenished on the trip; all can be had at very reasonable rates.

Good canoe cruising country is any section of large and small lakes connected by rivers and streams to form a maze of water trails over which trips of from 50 to 500 miles may be laid out and accurately mapped. From among these routes you can select a trip to suit your experience or lack of it, and if you wish to tackle the more arduous ones you can have a guide along.

Handle With Care is the rule for canoes. Light but tough, they wear well when treated considerately.

Easy going in typical canoe country—rugged and wild, with new vistas around every bend.

"Shooting" white water on a small stream. Rapids like this often look much more formidable than they really are, usually do not necessitate a portage.

Conditions range from semi-settled to virgin wilderness and throughout most such country the winding water trails are the only highways, the canoe the only practical means of travel. The scenery is ruggedly magnificent, the climate cool and invigorating; fish abound and opportunities for photography are unexcelled. The routes include, in most sections, cleared campsites at strategic points along the way, signs to mark springs, portages, and so on, and blazed trails. But the wildness of the country remains unmarred.

The Superior National Forest—Quetico Provincial Park of Canada Country, easily reached by road or rail to Winton, Minn., is a wilderness section of lakes and connecting streams over which innumerable cruises have been mapped, as is Minnesota's own Basswood Lake region. In Maine country as wild as can be wished for can still be found on such cruises as the 200-mile St. John River trip; the man who wants placid going where experience can be gained along the way can take one of the lake and river or deadwater cruises such as the 125-mile Kennebec River trip or the 200-mile Moosehead Lake route and have villages and settlements break wilderness travel. In between, either short or long cruises afford alternate smooth runs and short portages around rapids with convenient campsites along the way. The Lake George country affords interesting cruising among the many small islands there and is easily reached by either rail or road. As for Canada, one could spend a lifetime of vacations there and cover only the principal of her canoe routes. Northern Ontario and Quebec, especially in the Manuan River country, are a canoeists' paradise.

Because in all these sections catering to canoe parties is an important part of the vacation business either state or private interests will be only too glad to help you plan your trip. The Conservation or Development Commissions of the different states, usually located in their capital cities, and the Canadian Government Travel Bureau at Ottawa all publish literature about these routes and will supply maps and descriptions of the different cruises, tell about rail or other transportation to them and give names of outfitters. These firms in turn will tell you how their outfitting plans work, suggest cruises to suit your experience or recommend a guide.

They have different plans to offer. One may make a flat charge of $30 for a complete outfit for two persons over a two-week period, providing a good canoe and proper small tent, rubber air mattresses, cooking and eating utensils, and such odd necessities as a handaxe, grate, lantern, and so on. Most outfitters supply blankets or sleeping bags as

Continued

A Motorless Vacation For You

Chains of placid lakes are vacation highways for canoeists.

Guides, mostly older men, are veteran woodsmen, good cooks.

Portage. Carrying a canoe is easy, with practice.

well, but in this particular plan you have to bring your own, and supply your own food, too. As this plan is used only in settled sections, however, as on Lake George, you can buy to advantage at village stores and always secure garden stuff, poultry, eggs, butter and home-canned things along the way. Such an outfitter will be glad to suggest different food lists and, of course, fish caught from day to day are always welcome additions to the larder.

Other outfitters provide a full outfit for $3 a day per person, including in this case blankets or sleeping bags and a well thought out supply of food, in addition to the canoe and gear mentioned above. This is the best plan where a wilderness section will be traversed with little chance of replenishing supplies. Even under today's rationing system outfitters, with their accessibility to farm cured meats and home canned produce, should have no trouble providing you with plenty of food.

These two plans cover cruises on which a guide is not needed. If you are at all familiar with boats of any type, even a rowboat, you can master the rudiments of paddling the first day out and [*Continued on page* 152]

THE MAN WHO STAYED IN BED

by George Daniels

Meet Jack Hammond, the man of more than 700 inventions. First of two articles.

John Hays Hammond, Jr., in one of his few quiet moments.

EVERY day of your life you are bound to hear of or use at least one of the inventions of John Hays Hammond, Jr. When you turn your radio dial to hear a newscaster tell of fires raging in Berlin after an incendiary bombing by Allied fliers, you owe thanks to three inventions pioneered by this ace American scientist. The single-dial tuning and the super-heterodyne circuit of your radio are two—and the incendiary bombs are the third.

Jack Hammond, as his friends call him, has sent more than 700 inventions to the Patent Office in what might be called his spare time, for he is one of the nation's foremost business men as well as an inventor. Recognized as one of the world's greatest engineering leaders, he is also president of the Hammond Research Corporation of Massachusetts, president of the Radio Engineering Company of New York and of the Hammond-Colley Marine Engineering Co. of Boston, director of RCA, director of the Blue Network, and consulting engineer of numerous other concerns. That keeps him busy.

It is understandable that many of his inventions are designed to make life easier, for despite a keen enthusiasm for his work, Jack Hammond enjoys a bit of leisure like the rest of us. Tall and athletic in build, he is a born sailor, and in peacetime sailed his own schooner about the world whenever he had time for a little diversion. On land, he is happiest when he is working in the laboratory, but his actual inventive work usually takes place elsewhere—sometimes on his way to a meeting, or perhaps, as he relaxes with an after-dinner cigarette.

"People generally think you are not busy if you are not moving about or doing something obviously active," he says, "but that isn't true of inventors. They are always busy, because inventing gets to be a habit—even a casual conversation about some unrelated thing may start an idea on its way."

Some of Hammond's busiest days in science are spent in the comfortable surroundings of his New York apartment, the telephone providing the link between him and laboratory workers hundreds of miles away. "Most people no longer fully appreciate the telephone," says Hammond, "yet it enables a man to accomplish a tremendous amount of work without even going outside of his house, or for that matter, without even getting out of bed—" With a twinkle in his eye, he suggested that some amusing fiction might be built around the telephone, and the part it might play in world-shaking events. As a title, he suggested, "The Man Who Stayed in Bed." His idea is that a plausible, if not realistic, story could be built around a man with great personal power who starts a war, cleans up a fortune out of it, and ends it—all by telephoning the right people at the right times, and saying the right things to them. Literally, he could stay in bed during the whole process. Far from staying in bed himself, however, Jack Hammond has never been able to find time to write it.

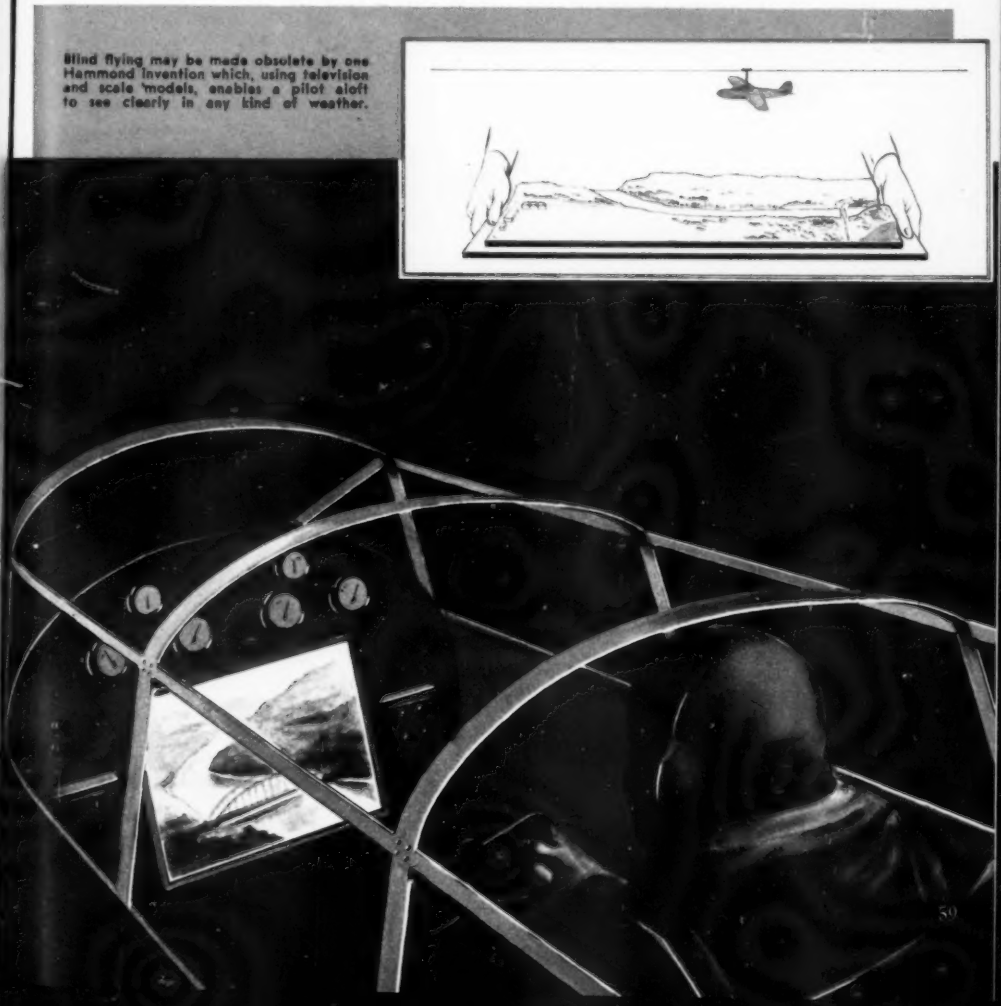
Among his more recent inventions is an aircraft instrument that will enable even the inexperienced post-war pilot to take a high speed ship through a mountain pass in a

blinding snowstorm, and see a sunlit view of a hidden airport in the middle of the night. There is nothing untried or doubtful about this invention, as its various components are already being used for various purposes throughout the world.

The instrument is really simple in operation. As the ship flies toward the airport, three devices on the ground, similar to the Radar type aircraft detectors used in British night fighters, pick it up simultaneously. Then each of these little electronic units follows the ship automatically as it moves through the sky. The angle at which each detector is inclined during this process becomes a factor in an automatic position-finder, and this, in turn, moves a tiny model plane over a model landscape just like that over which the real ship is flying.

The model plane carries a tiny television image-pickup which transmits what it "sees" to the actual plane in the air. When the little plane is over a model of Mount Penn, the image projected on the windshield of the actual ship is that of the model of Mount Penn, complete with houses and roads. It looks like the real mountain, and it shows up the correct distance ahead or below. If one of the television operators places his finger on the model mountain peak, a giant finger will appear in the image in the actual ship's windshield. A 50-foot cigarette butt on the slopes of Mount McKinley might similarly be the result of a carelessly parked smoke.

As for getting through the mountain pass, the Hammond radio trail system developed in conjunction with E. F. W. Alexanderson of the General Electric Company, provides the answer. Unlike the well-known radio beam, which takes a straight horizontal path,



Blind flying may be made obsolete by one Hammond invention which, using television and scale models, enables a pilot aloft to see clearly in any kind of weather.

The late John Hays Hammond, Sr., adventurous, world-girdling mining engineer.

encountered sailing conditions under which it was impossible to hear the whistle signals of approaching steamers. As these whistle signals are a very important factor in ocean traffic (telling among other things, on which side of you the other fellow plans to pass) it seemed to Hammond that an invention was in order.

He had never found the steamers much of a problem in themselves, because it was a simple matter to count the puffs emitted by their steam whistles. Ships propelled by Diesels, however, all have air whistles. These didn't emit any puffs of steam, and when the steamer pilots couldn't hear them, they couldn't see them either.

this system consists of numerous vertical signals, and can lead the pilot on the most devious, zig-zag route when necessary. Another of Hammond's aerial radio guiding devices employs ordinary wires, strung on poles along the ground like telephone wires. These provide signals of great strength for thousands of feet above their path on the ground. After the war, lines of this type may guide civilian aircraft along hundreds of sky highways.

But Jack Hammond's inventions are by no means limited to radio. Practically everything he does, whether for business or pleasure, stimulates the inventor in him. While he was sailing his schooner Odysseus III along the coast of Labrador he decided that the available fog lights weren't what they should be. It didn't take him long to develop one that employed photographic photoflood lamps instead of the conventional bulbs. The result was a light of many times the power of the regular type—and inexpensive besides.

On other occasions Hammond

Jack Hammond's castle home at Gloucester, Mass., is a wonderland of his hobbies and inventions.

Continued

The Man Who Stayed in Bed

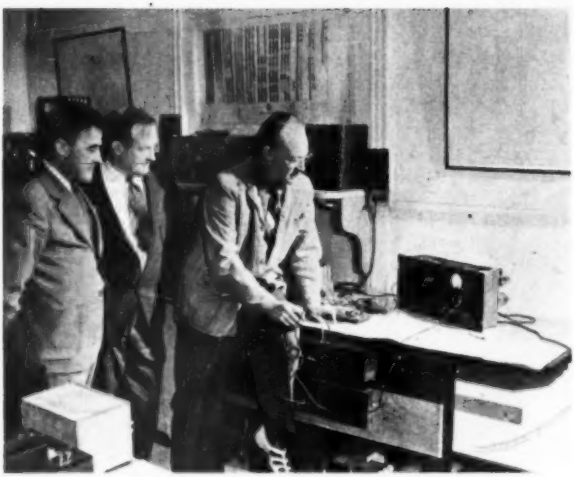
The answer was an invention that no doubt made many an old seafarer rub his eyes and swear off drinking. It was the steamless steam whistle. Perched high on the Odysseus III's mast, it sent forth great puffs of chemically made artificial steam with every toot. With bulging eyes, the steamer pilots could see it whether they could hear it or not.

All of this, plus an experimental short wave testing laboratory aboard, must have made the Odysseus III feel somewhat out of character. She was converted from an ex-rum runner, Diamantina, and was doubtless unaccustomed to such intellectual activities. But she was a good ship, and even better for the fact that inventor Hammond re-rigged her in the course of experiments designed to give steamer speed to sailing vessels.

Jack Hammond's liking for good music has taken him to every opera so far this year, and to a goodly number of concerts as well. In the past it prompted him to make a try at violin playing, but, says Hammond, "I found I was a much better listener than violinist."

As might be expected, the inventor in him asserted itself. *Pirafon*, the only volume-controlled piano ever made, is his invention. You can play a tempestuous bit of Stravinsky on it at four o'clock in the morning in a paper-walled apartment, and even the most disagreeable neurotic in the next flat won't complain—because you can tune your *Pirafon* down to a mere tinkle. On the other hand, although it is more compact than your old

Hammond's demonstration of his mechanical dog, which later turned into a radio-controlled ship, amazed high-ranking U. S. Army officers.



Last year Mr. Hammond offered to the U. S. Government a radio transmitter and receiver using spiral waves which cannot be intercepted by enemy listeners. Here he demonstrates it to two fellow scientists.

parlor upright, it can produce enough volume to fill the largest concert hall at the turn of a dial. Before the war, this amazing instrument was in production by one of America's leading piano makers. *Pirafon*, incidentally, also operates as a radio and a phonograph.

Hammond's castle at Gloucester, now known to the public as the Hammond Museum, contains many of his inventions devoted to the enjoyment of music. One of them is an organ that helps out the musician during complicated passages, by doing some of the work for him. "The ordinary pipe organ is such a remarkable instrument," says the inventor, "that even the most accomplished organist cannot do justice to its many capabilities—so I thought I'd try to help him out by making the organ do more of the work."

The result is the Hammond Orchestrator, in which music rolls generally similar to those used in player pianos control all the playing of the organ's notes and all the manipulations of its many stops. The organist's role becomes that of a conductor controlling the tempo of the music, and the proportions of sound, to bring out the brasses or woodwinds at the proper passages. Aided by the Orchestrator, one organist, says Mr. Hammond, can produce a variety of modulations which without such aid could never be produced by less than seven or eight organists.

Music helps Hammond to work out technical problems at times, and his castle is well equipped to supply him with it whenever he is in the mood. The 100-ft. auditorium contains two dozen loudspeakers, carefully arranged to afford the best acoustical effects. Operating from the mysterious circuits of one of his many record-players, their reproduction is so realistic that one is likely to look for the orchestra on the stage.

This realism is achieved, of course, through another Hammond invention, the Dynamic Multiplier. This employs a sort of electrical "brain" to select certain passages for amplification, and allow others to remain at lower volume. Incorporated into phonographs by several big manufacturers, it was acknowledged a revolutionary advance in receiver design, when the war put an end to civilian radio production.

Hammond's inventions range all the way from a mechanical dog to a radio controlled battleship, and strangely enough, those two have a direct [*Continued on page* 152]

First successful demonstration of a radio-controlled boat was given by Jack Hammond's power cruiser Natalia, successor of the mechanical dog, in 1914.

You may worry about missing the boat

but here is one worry you can avoid

YOU can "miss the boat" these days, if you lose the use of your car. And lose it you may, if irreplaceable engine or chassis parts break down.

Even though you drive your car much less, it needs regular care. Batteries go dead for lack of use, tires need constant checking. Water and sludge in crankcase may rust idle bearings and pistons. Scale and rust can ruin your radiator.

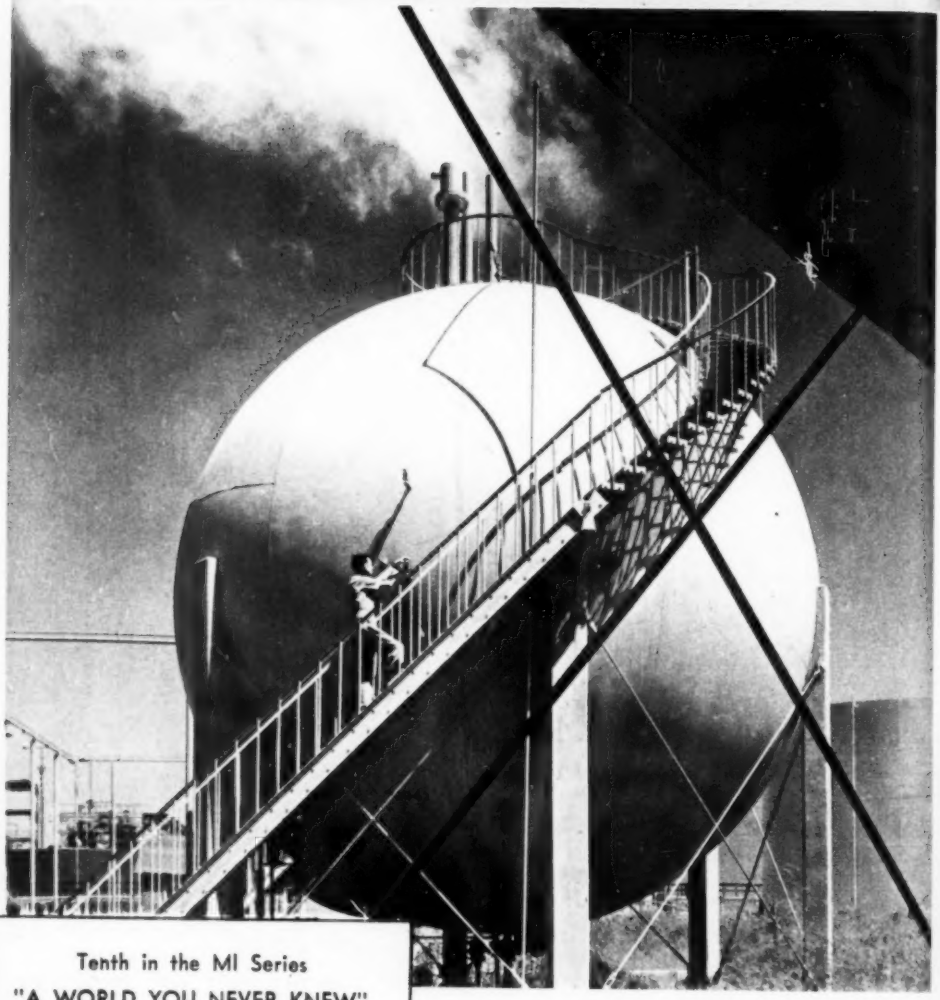
Avoid such worries with Marfak 40-Point Chassis Lubrication Service. Your dealer checks your car, point by point, from fan to differential *against his Marfak chart.* No guesswork here. Marfak means *accurate* protection for every vital part.

That's why your car is *right,* when it's had Marfak Lubrication—*right* for keeping it on the job for you and Uncle Sam. Insist on genuine Marfak Lubrication. At Texaco and other good dealers everywhere.

TUNE IN: FRED ALLEN every Sunday night. See your local newspaper for time and station.

You're Welcome at **TEXACO DEALERS**

COMING MIRACLES OF C



Tenth in the MI Series

"A WORLD YOU NEVER KNEW"

Like something out of a Buck Rogers' world is this Standard Oil storage tank used by chemists in manufacturing newest gasoline.

WHEN you buy a quart of milk, an automobile, a new hat or a pet Scottie you don't stop to reflect that what you are really purchasing is a specialized package of atoms and molecules. You don't, that is, unless you are chemically minded, and even then you don't phone down for a ton of hydrogen and carbon atoms, but ask circumspectly for a ton of coal.

Yet almost everyone realizes these days that every material substance in the universe—including your own distinguished person—is made up of limitless combinations of 92 elemental atoms. That's all there are; there aren't any more. Out of them, however, if you are smart enough, and have enough of the right molecules and atoms to work with, you can make anything known to man and literally millions of things that man (or nature) hasn't yet discovered.

CHEMISTRY

by Donald G. Cooley

Chemists are getting just that smart. True, they have a long way to go: in spite of the chemical marvels we have known, we haven't seen anything yet. Up to now chemistry has largely been a matter of taking natural products of the earth and converting them, sometimes crudely, sometimes cleverly, to man's uses. The new chemistry goes deeper. It takes fundamental building blocks of the universe and *makes to order*, custom builds, countless substances that nature wasn't smart enough to invent.

Consider the synthetic rubber tires you'll own one of the days. Look good to you, do they? Are you astonished to learn that those fresh, crisp treads have rolled 100,000 miles? The tires will last as long as your car. Tests with synthetic rubber tires show that they don't slide all over a wet or muddy road as natural rubber does. They're safer; skidding is minimized.

Synthetic rubber is a good starting point in looking at the new chemistry. In the first place, it's a huge joke on the Japanese. The Japs are temporarily in control of the Malayan plantations that provide most of the world's natural rubber. Synthetic rubber, however, has no more need of a rubber tree than a submarine has for a parachute. In fact, the synthetic product is not rubber at all. It is an assembly of molecules derived from coal, petroleum, limestone, or alcohol that some farmer planted as rye or corn. There goes your Malayan rubber empire!

Thus you see chemistry working a terrific international revolution. As far as natural rubber is concerned, the U. S. is a "have not" nation. But in synthetic rubber we are a "have" nation, with a vengeance. We have the molecules and know how to use them. Practically all other nations have those molecules too. They need no longer be subject to natural monopolies. The impact upon relations between nations staggers the imagination. Chemistry is abolishing a major cause for wars, insofar as these arise from hungry nations reaching out for their neighbors' riches.

In the second place, synthetic rubbers are better than the natural product. Chemists know at least 3,000 formulas for making rubberlike substances. Add an atom here, take one away there, and you have a superior "rubber" tailored to the job's specifications.

The Chevrolet Iron Foundry now is pouring magnesium castings—significant of the new trend to light metals brought about by the magic of chemistry. Here the volatile metal is poured.

Dr. Harvey C. Rentschler of Westinghouse tests an ultraviolet lamp of a type which may make air free of bacteria and viruses an everyday health safeguard.

In the third place, synthetic rubber will be cheaper. That is the invariable history of synthetic products. Working with molecules en masse, applying assembly line methods, devising shortcuts, getting raw materials from inexpensive sources such as coal and air and water, chemists cut costs all along the line.

This in turn opens up new uses. You can imagine highways of tomorrow surfaced with a rubber coating impervious to frost and moisture, flexible enough to expand or contract without buckling or cracking. Chemical compounds make it skidproof in all weather, cut down accidents. Riding is unimaginably smooth and silent. Soon our synthetic rubber plants will be turning out 1,100,000 tons a year—about twice the tonnage of natural rubber that we used to consider lavish for our needs.

Then there is the coming age of plastics. We haven't scratched its surface—an appropriate figure of speech, since most plastics are unscratchable. Originally, "plastics" meant substances that are moldable. Bakelite and celluloid were the original examples. Now we have hundreds of plastics and undoubtedly there are thousands of others, better ones, yet to be formulated. The molecules making them may come from camphor, soy beans, coal, water, corn stalks, air, peanuts, coffee, milk. The list is endless.

Post-war homes will undoubtedly be built, in many cases, of plastic panels, fabricated in mass production, assembled in a day's time. They are smooth and warm to the touch. Plastic floors are silent to walk upon and won't splinter. Wallpaper designs or fullsize, natural-color murals can be incorporated by cheap photographic means. Cleaning is a

Continued

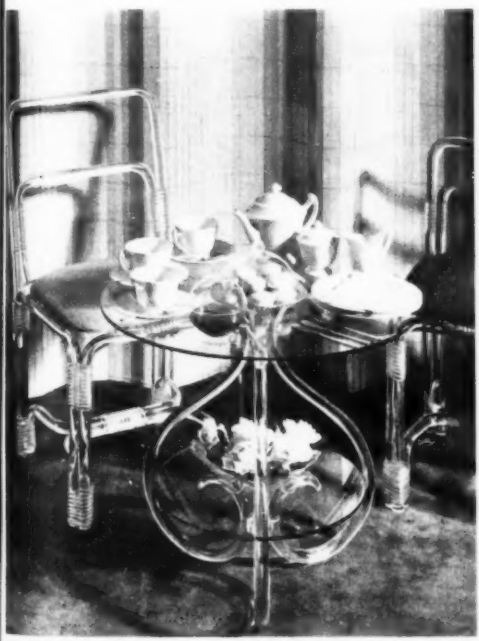
Coming Miracles of Chemistry

mere matter of a damp rag brushoff. Rolling pins, children's toys and other domestic hazards won't dent them. Outside, the plastic finish is impervious to weather. Older houses can apply a coat of plastic paint to last a lifetime. Similar paints will give the equivalent of a marble top to tables or kitchen counters. Windows of transparent plastics will be shatterproof, lighter than glass.

The next step in plastics will probably be the incorporation of metal, silicon and calcium atoms. Then you get plastic stone, marble, steel, stronger than the natural products but perhaps one-fourth as heavy. Apartments, factories and skyscrapers using plastic slabs on the exterior will present striking new beauty. The dull reds, grays and yellows of brick and stone can be varied with a rainbow variety of colors. Metallic plastics will make such heavy objects as a piano light enough to be carried upstairs by a boy on each end.

All furniture, for that matter, faces revolutionary redesigning. Cabinet work as we now know it is a matter of costly skills. No doubt it will always have its place. But the average home owner will hesitate to pay for carving, sawing, joining, screwing, gluing, and hand finishing when he can get a product of equal appearance and better durability at half the price. Plastic furniture need only be pressed in a mold, a single operation. If you like a hand-rubbed mahogany finish, you can get it in a plastic coffee table into which you can't burn an insurance claim with a cigarette butt, nor mark with rings from the bottom of a tall glass.

Fabrics treated with ammonium sulfamate lose none of their beauty, refuse to burn even when held in a flame.



Chairs, table base, food cover and jar made of plastic Lucite point the way to chemistry's conquest of post-war furniture.

Plumbing is in for a housecleaning too. Instead of heavy metal pipes requiring tedious cutting, threading and joining, plastic pipes can be bent to conform to wall space and ends joined together by a simple heat fusion. A plastic bathtub, minus the chill of porcelain, should weigh around six pounds, laundry tubs about the same. Refrigerators, cupboards, stoves and the like will be among the earliest to be made of plastic shells.

Wood itself, when impregnated with plastic resins, takes on new qualities. It can't be fired with a blowtorch. Termites can't stomach it. Under pressure it can be molded into any conceivable shape and is already being used in making one-piece airplane fuselages of extraordinary strength. Plywood so impregnated and shaped will have wide uses for furniture and structural purposes. Every house can have a plastic sunroom, transparent [*Continued on page* 146]

BEFORE THE P-38

Tailless Pteranodon, above, had tubular bones with walls of pasteboard thickness, brain like a bird lacking sense of smell. Span was over 20 feet, cruising range around 200 miles. Wings folded at body and half way out.

by Willy Ley

Mechanix Illustrated Art by Fred Ripperda

THE helicopter and the airplane are nothing new to Mother Nature. Her giant living airplanes were soaring above what is now the United States, millions of years before man even came into existence. England too, was a proving ground for many strange flying creatures—and any dinosaur that happened to be thumping around the Dover area, was doubtless startled on many occasions by what floated overhead.

Only a few feet short of modern pursuit plane span, some of these animated sportplanes were tailless flying wings—hundreds of millions of years before Northrop thought of it. Others, like *Rhamphorhynchus,* stole a march on Walt Disney and Rube Goldberg. Even his fellow saurians must have tittered when Rhampy took the air. He was something like a hairless rat with the hind legs of a modified frog, wings like a bat, and a head like a baby alligator—except that he had a tuft of bristles as a crowning lovelock. He carried his tail at the end of an outrigger three times the length of his tummy, and spent his time swooping around like a sea gull. He'd plop into the water, gulp down a dumbfounded fish, and then somehow get into the air again. To this day nobody has been able to figure out how he took off from the water—but we know he did it.

But we don't have to go back millions of years to see Nature's helicopters. Bees, flies, mosquitoes, humming birds, and a host of other living things can do everything the man-made helicopter can do—and more. They can hover over a given spot, back up, rise vertically, or move in any direction their little hearts desire. And what's more, they all operate on the same basic helicopter principle.

Even lighter-than-air flying is old stuff to Mother Nature. Not many of us know about it, but countless millions of balloons are produced and flown over the forests of northern Europe every year—and the factories that turn them out are trees.

All of these living aircraft serve to show us one very definite fact; man didn't invent anything in the way of aircraft, and he was quite a few million years behind Nature in developing the technique of flight. The perfection of this so-called modern means of transportation was evolved by Nature, through the medium of prehistoric monsters

that few sober minds could contemplate. Even at that, millions of years went into the development of flight.

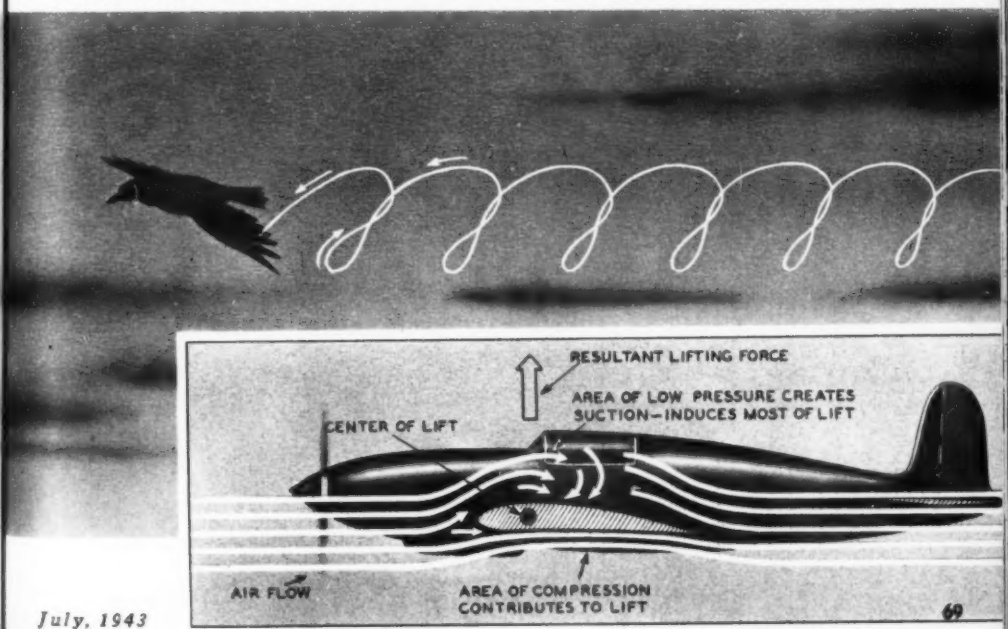
It first materialized—we don't know how—some 250 million years ago in or near the forests which during countless generations of individual death piled up the coal seams which we now dig from the ground. The inventors of flight were, of course, not human for the very simple reason that human beings were not due to appear for another 249 million years to come. The inventors were a kind of insects, not very closely related to, but looking to a large extent like our present day dragon flies.

They were of enormous size, and it so happens that they were not only the largest flying insects known, but the largest insects of any kind, whether flying, crawling or jumping. The *Palaeo-dictyoptera*, as they have been named by paleontologists (the name has a definite meaning but is awkward to translate) spanned a full twenty-five inches from wing-tip to wing-tip. This earliest known model of a living airplane differs from all later designs in one interesting point: a third pair of small wings can be seen in front of the two large pairs. It is believed among experts that the unknown ancestors of the known forms had six wings of equal size, that insects started out with three pairs of wings as they did with three pairs of legs. The six legs have been retained all the way through, the wings have been reduced to four and in a large minority of cases even to two.

To state that flying was invented 250 million years ago by these archaic super dragon flies is not just a literary device. No point is being stretched by calling them the forerunners of later human aviators. Many famous pioneers of flight have stated that they got their desire to fly when they watched birds wheeling around in the air. Consequently it is hard to find a book on aviation that does not start out with the sentence that "the wish to fly is as old as humanity." There can be no doubt about the truth of this statement. But there can also be no doubt about the conclusion that the wish itself might never have been conceived if there had been no flying insects and birds to watch. The very word *aviation* is derived from the Latin *aves* for birds . . . "aviation" really is the science of bird imitation.

We know, however, that there is more than one way in which flight can be achieved. There are two main groups of flying machines: balloons, blimps and airships on the one hand and everything else on the other. Balloons and airships actually swim in air, in the same sense of the word that applies to a fish

Bird wing tips describe series of figure 8's when flying, *below*, a of soaring bird. Wing sections of fast and slow planes resemble wings must serve also as propellers. Plane wing acts like that in their general design those of fast and slow birds, respectively.

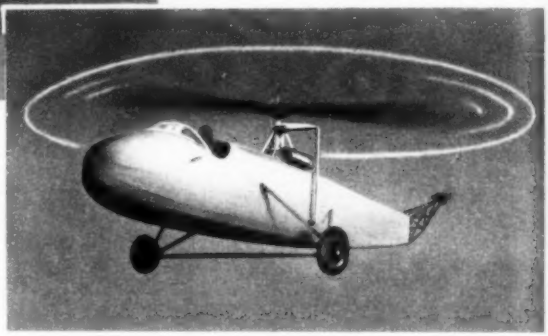

RESULTANT LIFTING FORCE
AREA OF LOW PRESSURE CREATES SUCTION—INDUCES MOST OF LIFT
CENTER OF LIFT
AIR FLOW
AREA OF COMPRESSION CONTRIBUTES TO LIFT

For vertical ascent, fly's wings create downwash below, and low pressure area above insect

green forests of these trees you can see the pollen like golden clouds hovering over the forest all day long.

The microscope revealed the reason for this hovering ability. Each pollen grain has two tiny membranous bags attached to it, each bag enclosing a minute amount of air. When the sun strikes the male "flowers" of the trees the air in the membranous bags begins to expand because it grows warmer. The lifting power is large enough to make the tiny grains float upwards, to be carried about by the wind, until the sun settles below the horizon.

Now we come to the other group of flying machines, collectively



Helicopter operates on same general idea as housefly. Whirling rotor drives air downward beneath blades while creating low pressure above (lift).

swimming in water. Balloons and airships weigh as much as the volume of air displaced by them. If they weigh less than that volume of air they rise to a level where the weights are equal.

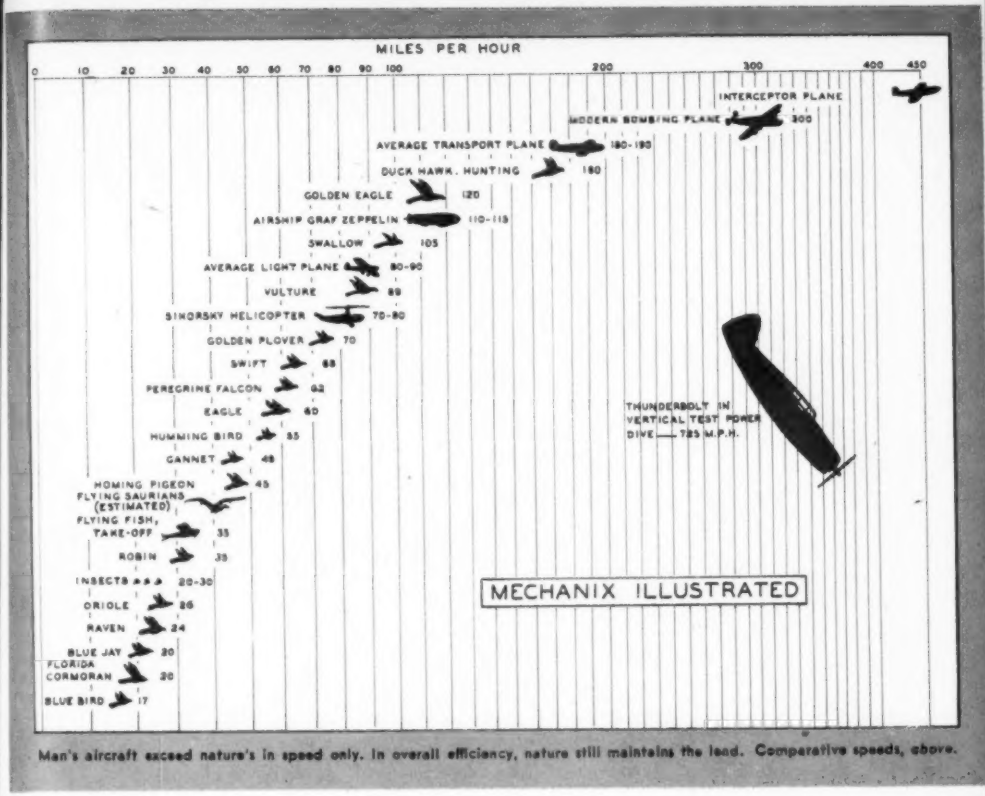
The name for this method of flying is "aerostation" or "lighter-than-air" and it looked and still does look to many observers like a specifically human invention. No animal of any kind had ever invented a balloon, consequently the inventors of the balloon had not been guided by a living model of any kind. But later, just about a century after the invention of the first balloons by the brothers Montgolfier, it was found that at least a plant, if not an animal, had made the same invention. And that brings us back to the balloons of northern Europe. There, a species of pine trees, labelled *Pinus silvestris* by botanists, also took advantage of the fact that warm air is lighter than the same volume of cold air. The pollen of that pine tree looks like golden dust, and when the sun shines over the dark

called "heavier-than-air." In the range of human inventions they go all the way from completely passive devices like parachutes through the intermediate type of the glider to the active types, airplanes and helicopters. In Nature we can find the precise equivalents of these inventions, passively drifting parachutists, semi-active gliders and very active fliers, like the birds.

Man always wanted to imitate the birds, but until Kitty Hawk he invariably and usually unknowingly imitated one of the other, much less known forms, provided that he was successful at all. There are quite a number of stories about flights performed in times preceding the invention of the balloon. One of them, which sounds more credible than many of the others, tells of a flight made by an artisan in Moscow under the reign of Czar Ivan the Terrible. The flight, the story

Continued

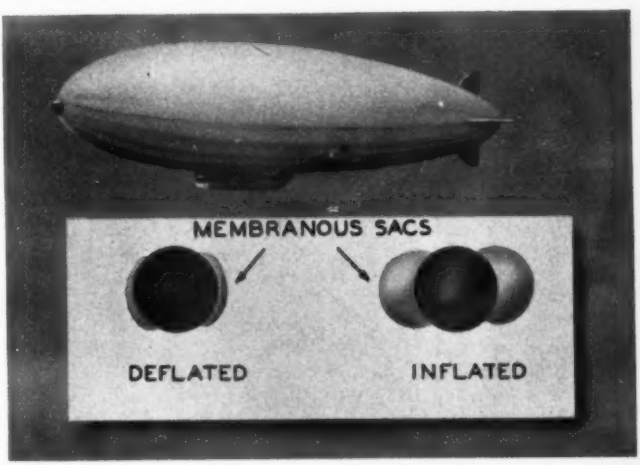
BEFORE THE P-38



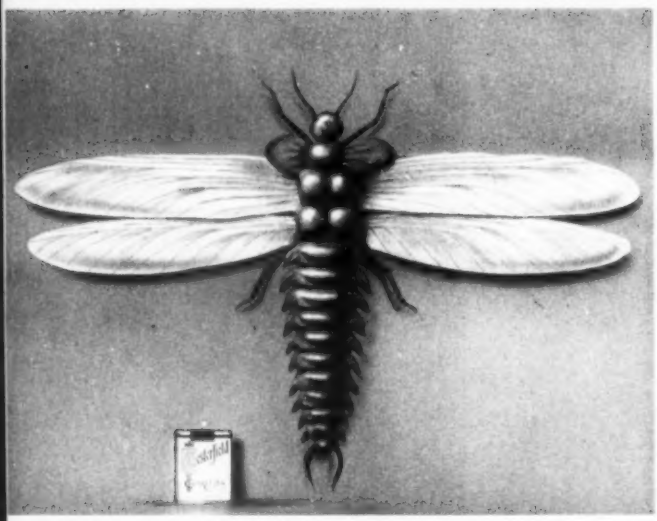
Man's aircraft exceed nature's in speed only. In overall efficiency, nature still maintains the lead. Comparative speeds, above.

goes, was made from the high wall at *Kitaigorod* ("Chinatown," originally a Chinese section) and carried the artisan across or into the *Nyemetskaya Svoboda* ("German Freedom," the section where the German traders and artisans used to live). The brave artisan probably thought of himself as a bird-man . . . actually he imitated the Russian Flying Squirrel, a typical glider of the animal world.

There are many such animal gliders—best known are the flying squirrels of northern Russia and the eastern United States. In the Australian region there are flying marsupials that look very much like flying squirrels—zoologists know them as Flying Phalangers —and in the Malay States you can find the Flying Lemur, also known as *Galeopithecus*, the largest of the gliding mammals. The gliding mechanism of all these consists of a "flying skin" stretched between the fore- and hind-legs on each side of the body. In



Rising on the principle of man's *Montgolfiers*, or hot air balloons, pine pollen of northern Europe compares with blimps, minus helium.



Palaeo-dictyoptera, world's biggest insect, extinct for millions of years, had a 25-inch wingspread, was first thing on earth to fly. Package of cigarettes show its size.

some cases additional skin folds stretch between forelegs and neck and between the hind legs, embracing the tail, but the principle is the same.

The Flying Dragon or *Draco volans* from Java is another example of the glider principle, but the tiny lizard which hides behind this awesome name has a flying or rather gliding mechanism all its own. It consists of about half a dozen "false ribs" protruding from the body at either side, stretching a flying skin when the lizard jumps from a branch in pursuit of flying insects.

The flying fishes of the tropical seas are also gliders. Enormously enlarged pectoral fins serve them as wings for their expeditions into the air. For many years a heated debate raged intermittently about the question whether the flying fishes actually fly or not. The question has now been settled: they don't! They make a take-off run under water, emerging at an angle of about 30 degrees and then hold their fins stiffly stretched away from the body. That way, their jumps which might otherwise carry only five or six yards, are stretched to as much as 200 yards. But it is not true flight. A fish that lands aboard a vessel cannot take off again, and when thrown overboard it falls into the water like any other fish.

While all these living forms are at least gliders, one of them seems to be nothing but a parachutist: the so-called Flying Frog of the island of Java. It breaks its fall by means of very much oversized webbed hands and feet. Because of them it does not suffer any injury even when jumping directly to the ground from a very high tree.

The more interesting types are, of course, the active fliers, and there is no dearth of variety among them. The variety is even greater if you include extinct forms, the large numbers of flying saurians. They actually flew like birds, or better like bats, having their fore-limbs enormously extended as support for a flying skin. There is one important difference in construction, though, if you compare the wings of the bats and the wings of the extinct flying saurians. The skin of the bats is supported in an umbrella like fashion by all four fingers (the thumb being separate) while the skin of the flying saurians was supported by one very elongated finger only. Few of the flying saurians had very impressive dimensions, the size averaging that of a crow or a pigeon, with small sparrow-sized forms being fairly numerous. But one of them reached really large size.

It lived over and near the sea flooding what is now Kansas during the Cretaceous Period, some sixty million years ago. That sea has been called the Niobrara Sea and the saurian itself has been named *Pteranodon ingens* (which means "gigantic toothless flier") by Prof. Othniel C. Marsh, its discoverer. In addition to being toothless, poor Pteranodon couldn't smell. He had no smeller. The wingspread of Pteranodon was about 21 feet, but the weight of the tubular-boned animal probably did not surpass 30 pounds. He had a cruising range of several hundred miles. No other flying creature ever attained these dimensions again. The Wandering Albatross of our time attains a wing spread of about 11 feet (a record specimen measured 11 feet 4 inches) but usually the South American Condor is accepted as the largest bird. It rarely spans more than ten feet, but is generally heavier than the Albatross. The largest fruit-eating bats of the tropics attain a wingspread of between four and four and a half feet which is respectable enough.

[*Continued on page* 145]

SCIENCE IN PICTURES

Bazooka

ABOVE is the first released picture of the U. S. Army's new anti-tank gun, the amazing weapon familiarly known as the Bazooka. Light enough to be carried by two men, it can be fired by one, can blast any tank made and is even effective against fortifications. No details of the Bazooka have been revealed, but its admitted inaccuracy except at short range supports the belief that it fires a rocket projectile. At right are German rocket mortars captured recently in Russia.

July, 1943

They Hit The Spot

PICTURED *above* are three of the U. S. Army's first dive bombers; called A-36s, they are basically similar to the Army's famous P-51 Mustang, are, like Mustangs, built by North American Aviation. Their top speed is a military secret, but is known to be more than 400 m.p.h., making the A-36 easily the fastest dive bomber in the world.

Punch In The Pulpit

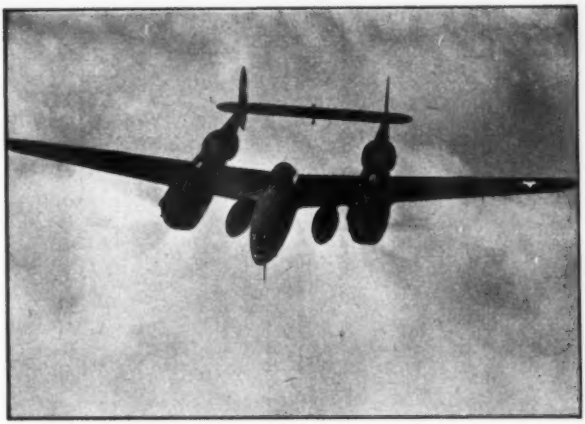
THIS is the way things look inside one of the Army's M-7 tank destroyers, stars of the desert fighting in North Africa, as its 105-mm. gun-howitzer is loaded. Note the cylindrical armor shield which protects the corporal in this picture; because of this shield's pulpit-like appearance the men of Britain's great Eighth Army call the M-7 The Priest.

Valiant Valentine

THOUGH many a member of Hitler's Afrika Korps has seen the sight pictured at *left*, none of them has ever been known to enjoy it. It is a British Valentine tank, higher in silhouette than the stubby, tough Churchill (MECHANIX ILLUSTRATED, December, 1942), but mounting a 25-pounder gun where the Churchill mounts only a six-pounder. Approximately equivalent to a 90-mm., or 3½-in., gun, the 25-pounder is powerful enough to blast even the heaviest Nazi Mark VIs, has in fact blasted many of them all the way out of Africa.

Long-Range Lightning

TO ADD still more miles to the effective reach of what is already this nation's farthest-ranging fighter plane, droppable auxiliary gas tanks are now being added wherever needed beneath the wings of Lockheed's famous P-38 Lightning. Weighing 90 pounds empty, each tank can hold 165 gallons of fuel. Two of them nearly double the Lightning's flying radius, cost the plane, fastest of fighters, only four per cent of its top speed even when full.

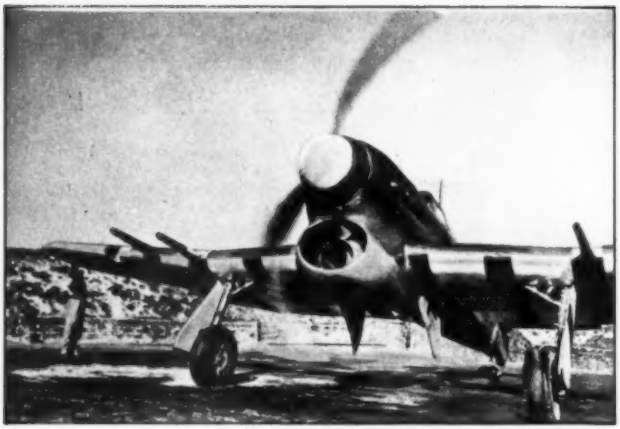


Ready For Tanks

PICTURED at *left* are Soviet soldiers on Russia's southern front, prepared to stop any German tank that may come along. The two men in the middle distance are armed with an anti-tank rifle, a small-bore weapon with high muzzle velocity. In the foreground a Soviet soldier holds a gun which fires an anti-tank grenade, sending the can of high explosive in an arc much longer and more accurate than could be achieved by the most powerful human arm. Note bomb-like tail on the grenade.

Army's Haymaker

THE slugger shown at *right* is the U. S. Army's new, versatile M-12—a 155-mm. gun mounted on an M-3 tank chassis. Adaptable to any purpose except anti-aircraft fire, the mobile M-12 can shoot a 95-pound projectile more than 10 miles, can easily demolish any tank ever built, wreck all but the heaviest fortifications, even sink a cruiser. No reports are yet available on the M-12's performance in battle, but it can safely be predicted that the Axis is not going to like it.



Tough Typhoon

AT LEFT is the first released picture of the R.A.F.'s newest and toughest fighter plane, the Typhoon. Though virtually all detailed information about this plane is strictly secret, it is said to be the fastest fighter in the world—faster even than a Lightning—and also the most powerfully armed of single-engined planes. Well past the testing stage, Typhoons have already seen action over Europe.

Home-Front Paratrooper

NOT all parachutists go into action on enemy airfields, armed with submachine guns. Some ply their dangerous specialty on the home front—like the fighter pictured at *right*, who is a paratrooper in the U. S. Forest Service. His touch-and-go job is to land in any heavily wooded, otherwise inaccessible territory in which a forest fire may start, and fight it with equipment dropped to him from Forest Service planes. He wears a fireproof coverall, heavy mask to protect his face from branches while he is landing

Big Inch Tailor

ROUGHLY similar to the wrappers which wind protective wire around the main cables of big suspension bridges, the three-purpose machine picture at *left* works to coat the Big Inch, longest pipeline in the world, against Nature's corrosives. After painting the big pipe the machine wraps it in tar paper, then drops it into a waiting trench. Working night and day, crews expect to complete the whole line by this July.

Safety At Sea

SHOWN above and at *right* being tested in Los Angeles Harbor is a new, experimental life raft. Rectangular and stable, the raft can hold many more men than most rubber rafts, has ample space for storing food and water as well. Fair-weather sails can be replaced by a canvas top in case of storms.

To The Rescue!

SPEEDED by a small airplane motor and an air propeller, the crash boat pictured at *left* is demonstrated in San Francisco Bay. Steered by an airplane-type rudder, the craft can navigate in the shallowest water or even over mud flats to the aid of fliers who may crash or have to bail out in places where jeeps or ordinary boats cannot go. Boats like this are on day and night duty at Hamilton Field, Calif.

Windmill Washer

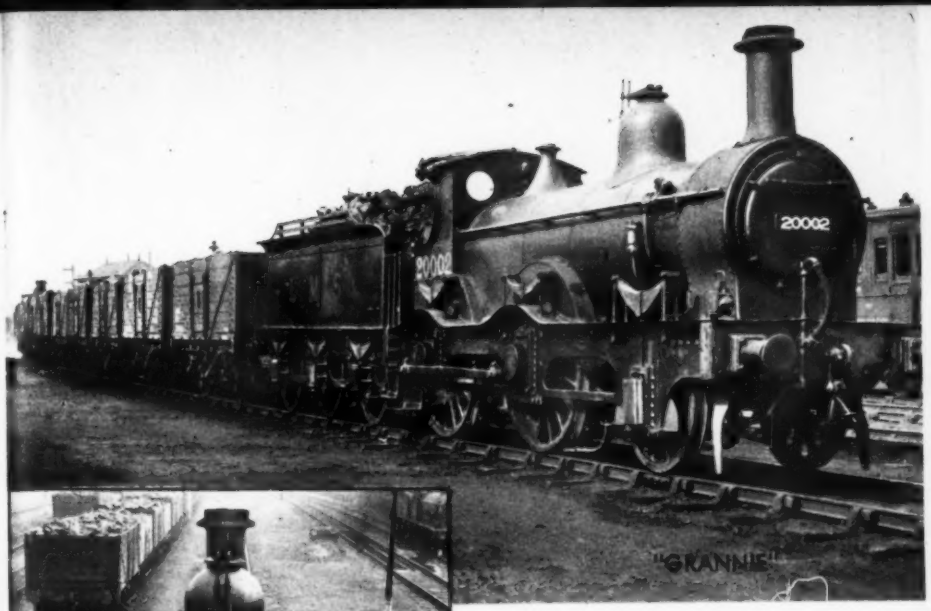
UNTIL recently, laundry in one Army camp in the Aleutians had to be done by hand—by everybody except Private Earl Krech. Private Krech invented and built the washing-machine pictured at *left*, letting the northern winds operate a windmill connected by chain and sprocket to a mangle which enthusiastically beat the grime out of his clothes, while all he had to do was hold the wash bucket steady.

Junior War Plant

THREE members of the Midget Manufacturing Company, of Chicago, are shown at *right* working on war production. Their job: making pants hangers for the Army. Manned entirely by high school boys, the MMC turns out as many as 2,500 hangers a day on a subcontract, using mostly non-critical materials. Left to right, these production-line soldiers are: Leonard Gallagher, 13; Gus Kamberos, 14; and Darrell Worker, 13.

Tojo Tries A Trick

A FREAKISH Jap innovation is demonstrated by Woodrow J. Phillips, BM 1c, U. S. C. G., *left*, who was with the first task force to land on Guadalcanal. It is a wooden bullet, built for a .30-cal. cartridge. Apparently the theory is that the wood splinters when it strikes its target. As the light bullet could hardly be accurate, however, or effective except at short range, it does not seem to be one of the Japs' brighter ideas.

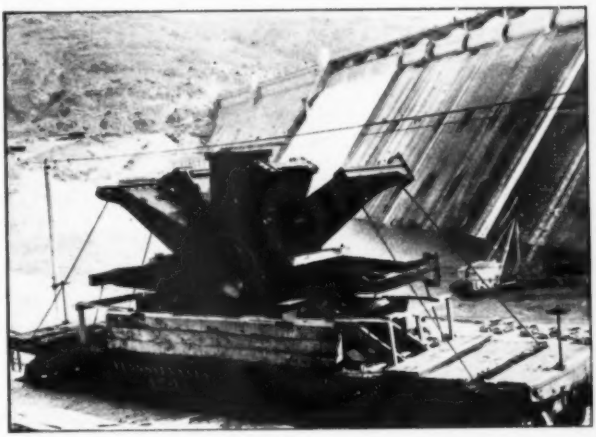


Sturdy Steed

THE iron horse pictured *above* and at *left* has the unique distinction of being Britain's oldest locomotive in regular service; she is the 20002, known to railroad men as "Grannie." When she was built in 1866 Grannie was the latest thing on England's railroads, queen of that day's fast express runs. Today, after 77 years of service, she has piled up more than 1,500,000 miles, is helping to win her third war. Note the high steam dome, the old-type controls and spring-operated safety valve in picture at *left*.

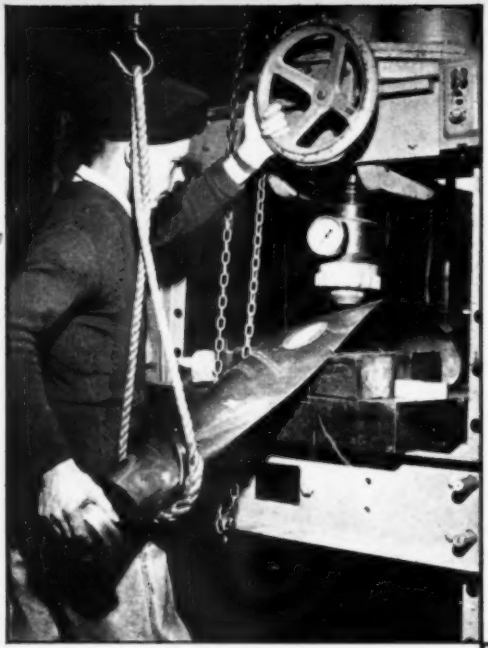
Spider For Coulee

ON THE last lap of its journey to Grand Coulee dam in Washington is the 62-ton "spider" shown at *right*. When finally in place, the huge wheel will form the hub and spokes of the rotor, or revolving unit, of one of the dam's great 108,000-kw. generators. To get the giant "spider" from Pennsylvania, where it was made, to the Pacific Northwest, required a special freight car, careful routing over bridges and through tunnels big enough to accommodate it.

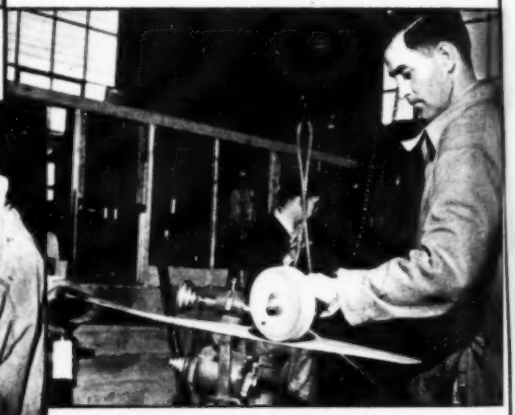


FIRST AID FOR PLANE PROPELLERS

TO THE skilled men who repair and recondition United Nations war equipment all over the world, every damaged part that can be salvaged and put back to work on the fighting lines is a victory. On this page is shown how one small shop in England handles its assignment in this vital job—repairing airplane propellers. Light, finely-machined props are less often damaged by enemy action than by the ordinary mischances that befall pilots taking off from or landing on bumpy ground, operating night after night out of darkened fields. Frequently the propeller is the only part of the plane that suffers damage in some unavoidable nose-over. But a plane without a workable prop is as useless to a pilot as no plane at all.



A badly bent propeller is placed in a jig to be straightened by careful application of slow and constant pressure.

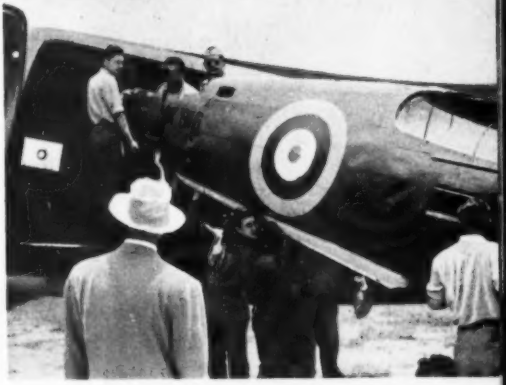


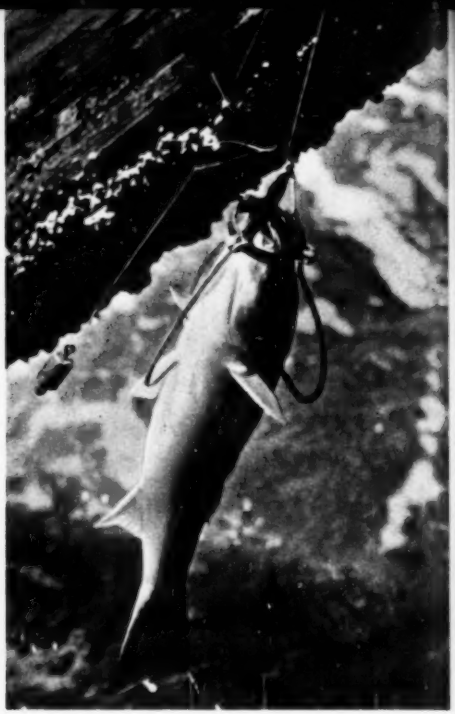
The tip of the bent prop has been straightened, *above*, is next polished and buffed to its original smoothness.

The refinished blade, *above*, is matched to its companion, and both are adjusted with precision gauges to hairline accuracy.

Back in action, at *right*, the once-useless prop does its part to pull a Bristol Blenheim low-level bomber against the Axis.

P-40s have flown fast and far in this war, but until recently no P-40 had ever flown inside a C-47. In North Africa, however, a Douglas troubleshooter was finding too many Warhawks at forward airfields damaged beyond the capacity of emergency repair shops, decided to try flying them back to main repair bases. The pictures on this page show how it was done. At *right*, the stripped-down fighter fuselage is trundled carefully toward the Skytrain's door; *below*, with an inch to spare, it angles in; *above*, it's set for a ride, firmly lashed in place. *Below right*, the P-40's wings wouldn't fit inside, made the trip secured to its belly. Operation a success.





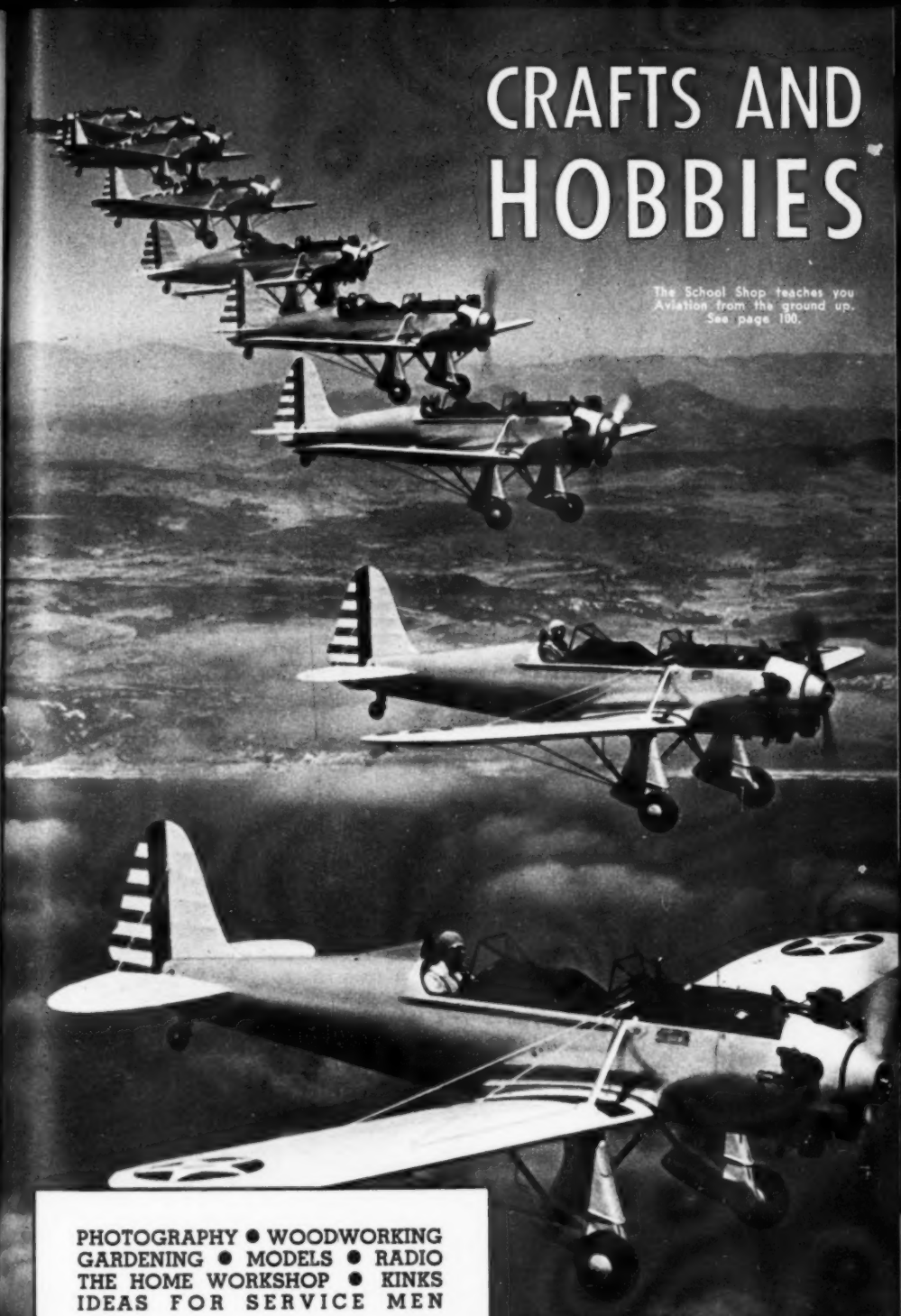
Blitz For Fish

THAT big one need never get away from a fisherman equipped with the gadget shown *above*—a mechanical gaff that grabs 'em and holds 'em. If you hook a fish too insecurely to be sure of getting him safely out of the water you simply drop this gadget down your line and over his head; its three hooks swing down automatically to clamp him firmly while you haul him in. The unhappy demonstrator is a striped bass.

Water For Jive

NOT satisfied with the Distinguished Flying Crosses they had recently been awarded, the two members of the R. A. F. pictured at *left* turned to inventing. Result: a phonograph that runs by water power. Geared to the turntable is a string-suspended bottle which, weighted with some water, turns the phonograph record as it descends. A little water does nicely for sweet or long-hair stuff, to keep the tempo down to a dignified level; a lot of it, on the right kind of record, sends you right out of this world.

CRAFTS AND HOBBIES



The School Shop teaches you Aviation from the ground up. See page 100.

PHOTOGRAPHY • WOODWORKING
GARDENING • MODELS • RADIO
THE HOME WORKSHOP • KINKS
IDEAS FOR SERVICE MEN

Photo-Print Lamp Shades

These photographic lamp shades shown above are both unusual and attractive. Their construction is simple.

by Beulah Ross

PHOTOGRAPHIC lamp shades serve the purpose of presenting a picture story in an attractive and interesting manner. They're easy to make, and should you decide to recover one of your old shade frames for a brand new effect, here's how to go about it.

Frames are usually made in four, six or eight panels and you must choose the number of pictures for your story accordingly. The baby of the family will make a nice subject. Pets, woodland scenes and vacation pictures also furnish an abundance of material. In addition to the frame you will need: one dozen sheets of Translite Projection Paper, large enough to fit the panels; about ten yards of leatherette lacing in a color to harmonize with your pictures (available at an Arts and Crafts store); a small punch, dime store variety; several clip clothespins; transparent oil colors; some clear shellac; and a soft bristle brush.

Translite paper is a duo-coated photographic paper [*Continued on page* 136]

Below: Holes are punched at equal distances along the edges of the pattern which is then used when cutting the finished Translite prints. *Right:* The finished panel is laced into place on the frame. Clip clothespins hold the panels temporarily.

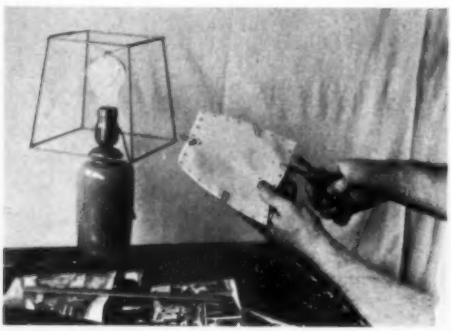


PHOTO CONTEST

FIRST PRIZE ($10.00) "Pride of Falconry" by Ernest Palinkas, 426 E. 67 St., N. Y. C. Taken with a Graflex on Super XX film, 1/110 sec., at f-8. Developed in D-72. The bird was alive when the picture was taken. SECOND PRIZE ($5.00) "Tower" by John Makar, 15041 Hartwell, Detroit, Mich. Taken with a Rolleiflex on Super XX film, 1/100 sec., at f-8, with red filter. Developed in DK-20. Print toned blue in gold toner. THIRD PRIZE ($4.00) "Caught in the Act" by E. D. Crawford, San Pedro, Calif. Taken with a Model I Contax on Plus X film, 1/200 sec., at f-8. Developed in DK-20 FOURTH PRIZE ($3.00) "Picture" by Ed. Arnold, 9 Winchester Pl., Burlingame, Calif. Taken with an Argoflex on Superpan Supreme film, 1/50 sec., at f-8.

1st PRIZE

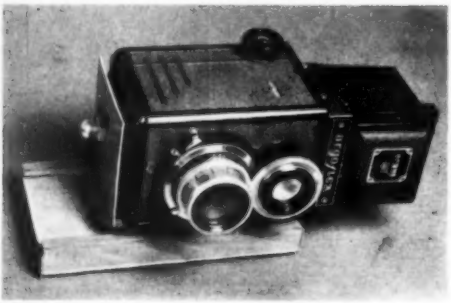
2nd PRIZE

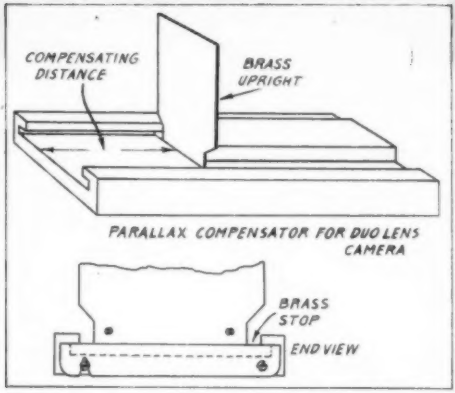
3rd PRIZE

4th PRIZE

Submit prints for this month's contest unmounted—no larger than 8x10 inches. With each print list your camera, film, lens opening and shutter speed, illumination, and developer. Write your full **NAME** and **ADDRESS** on the back of each print, and wrap securely with cardboard or corrugated stiffeners. If you want unused prints returned, **YOU MUST ENCLOSE RETURN POSTAGE.** (Published Prints cannot be returned.) Address: Photography Editor, **MECHANIX ILLUSTRATED**, 1501 Broadway, New York, N. Y.

PHOTO KINKS

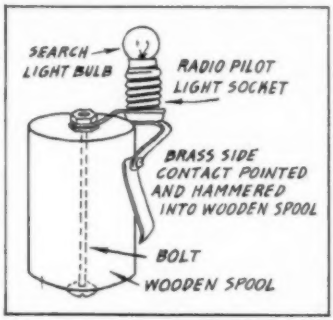




PARALLAX COMPENSATOR *(above):* When shooting closeups with twin-lens reflex cameras, the separation of viewing and taking lenses causes errors of image-placement, which may be overcome with the gadget shown above. The "compensating distance" is equal to the separation of the lenses.—*C. Howard Schotofer.*

A 10% potassium bromide solution, added to the print developer in the "proper" quantities permits full development of shadow areas without blocking up or graying of the highlights. A dropper bottle like the one shown at the *right* (taken from an exhausted photo solution) serves as a handy bromide dispenser. One "squirt" of the dropper adds about 1 cc. of solution.—*A. J. Lockrey.*

JIFFY FLASH TESTER. The gadget illustrated at the *left* and outlined in detail at the *right* will indicate whether current can flow properly through a flash circuit to each of the standard bulb sockets to be used; insert it as at the *left* and close the flashgun switch to see if the bulb lights. The wooden core from 35mm. bulk roll of Eastman film makes an excellent center.—*Louis Hochman.*



To test the temperature of solutions standing for some time, immerse thermometer in a glass of water which has also been standing on the worktable as at *right*. Its temperature will be the same as that of the solutions to be tested.—*Wm. Swallow.*

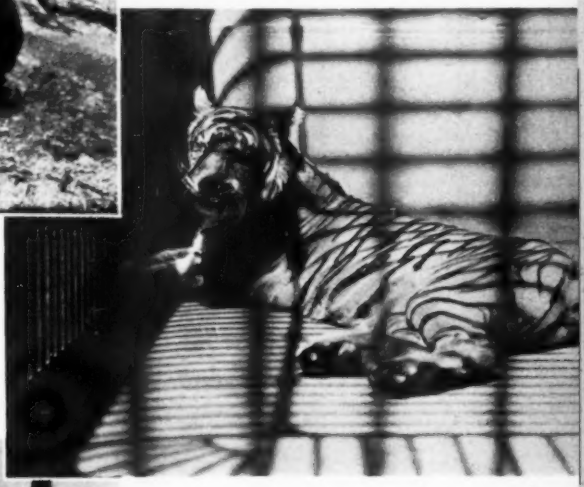
"Lookit The Animals!"

by

Robert Brightman

WHEN was the last time you visited your local zoo? Probably when led there by the hand by a doting parent. "Now let's go to the elephants." Five minutes there and off to see the seals. . . .

What with war restrictions, the zoo more than ever becomes a photographic haven. No military secrets here! The author visited his local zoo, and looking



Above: This bear liked to pose on his haunches; the only problem was to separate him from the other bears who were also begging for peanuts.

Right: "Queenie" was taken from outside cage with the camera lens wide open to throw the bars out of focus; texture was not lost in spite of this.

Below: This monk had just broken away from a free-for-all going on in his cage. He'd like to have a look at his picture but he'll settle for a peanut.

at it through eyes which had grown sharper and less round, he found that it simply abounded in picture taking possibilities. In fact, it was such a paradise of picture material that all of the accompanying shots were enlarged to 16x20, toned, mounted on heavy boards, and used as the decorative motif for a man's study.

These pictures were not the result of a single day's outing. A preliminary visit was made to note at what time of day the sun's position would be best for dramatic lighting. At the start, it was decided to make use of strong sunlight for all of the shots. Sunlight brought out the textures of the animals' skins and presented them in the best possible light. Fortunately, most of the cages and dens faced due

Above: The author, and photographer, found the lions a relief after the monkey house melee. This lion took a stroll around the cage after his meal, then sat down in the sun to pose for his portrait.

Above: The llama had been restless on two previous visits to his cage; this time he must have been overcome by the newspaper headlines, for he stood in one spot crooning to himself for fully five minutes.

west—into the afternoon sun—so it was merely necessary to wait until two o'clock or so before starting the hunt.

Each shot was made to count. For the nine accompanying pictures, only nine films were exposed; the shutter was not released until composition and lighting warranted it. Just pure patience and war-time conservation.

It was just as exciting hunting these animals with a camera as it would be with a gun. These animals were literally stalked for as much as three hours at a stretch in order to get them in just the right position. All of the pictures were made with a 3¼x4¼ Revolving Back, Series D Graflex, equipped with a 6⅜-inch Kodak Anastigmat Lens. The use of the Graflex, of course, made focusing and composition a relatively easy task. The film was Panatomic X, developed in DK-50.

Take a look at a concrete example—the tiger (page 87). This particular tiger would forsake its indoor cage for the outdoor one whenever the sun became strong enough. Because the bars intervened it was decided to shoot at f-4.5, the widest aperture of the lens, to put the bars out of focus as much as possible. It was also mandatory that "Queenie" be at the rear of her cage.

Queenie could not read my mind during my first visit. Finally, upon my second visit to her cage she obediently backed to the rear of the cage and settled down. Just before the shutter was tripped, a bunch of keys was rattled to attract her attention; hence, the quizzical and slightly annoyed look.

The elephant taking the drink of pipe water at the left was made after our first unsuccessful visit with Queenie. A shoulder-high fence surrounded the elephants' pen, which prohibited the use of the Graflex in its normal picture-taking position. Instead a vantage point was selected well back of the spectators. The camera was inverted and held high overhead. An unobstructed view of "Topsy" was then obtained, and when she lazily swung her trunk over for a guzzle of water the shutter was tripped, f-5.6 at

Left: Because of the shoulder-high fence in front of the elephant cage, the Graflex had to be held overhead from far back to produce a clear view.

1/100th second. Note the hair on her back—never knew elephants had hairy backs until this print was made.

The begging bear (page 87) and the polar bear shots on this page were both taken on the same day. Having adjoining dens, it was a simple matter to walk from one den to the other if one bear or the other did not perk up exactly as wanted. In spite of the difficult pose assumed by the brown bear, it seemed to be a natural for him. He and his fellow bears would often assume this begging position for a tidbit from the spectators. It was merely a question of getting this one by himself in the focusing hood without the intrusion of his fellow-beggars.

The shot of the seals, right, was taken with the Graflex just behind the rail. The seals really are a circus in themselves. They always cavort when a crowd is present, Sundays, and calm down during the rest of the week. It was necessary to take the seals from the far side of the pool as the crowd collected near them in the afternoon and a shot from the near side would have necessitated shooting directly into the sun.

The monkey (page 87) and the lion (page 88) were taken on the fourth Sunday and thereupon hangs a tale (no pun intended). On this particular day, the monks were rather restless. The spectators (who undoubtedly present the same appearance to the animals that they do us) had been throwing peanuts and candy into the cage until a general free-for-all developed as each tidbit was thrown. One monk picked up a peanut and had the flesh bitten off his thumb by another creature who coveted it (the peanut). The scared monk whose picture was taken is one that had escaped the general melee and seems to be pleading for rescue—or possibly an individually tendered peanut.

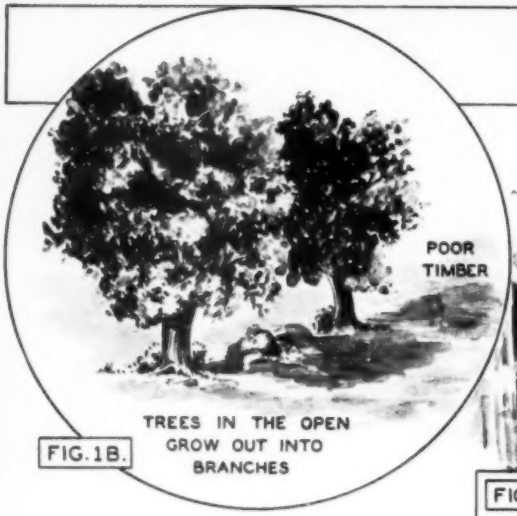
After the scrambled monkey cage, it was a relief to visit the lion house. Here sedate Leo was snapped in a reclining head portrait. The lion had just been fed, and after a few trips around his cage he decided to settle down in the sun—to my delight of course—and digest his meal. Thus ended the last of four pleasant Sundays at the zoo.

July, 1943

Above: Seals have to be caught doing something, with their eyes and mouths open, if they are to appear alive. Their black bodies tend to reproduce as a black blob unless the light catches their texture.

That's the same bear, *above* and *below*. He likes to plunge into the water on hot days to drown the fleas that plague him. If interested, you can find him at the Prospect Park (Brooklyn, N. Y.) zoo, any day.

WORKING



TREES IN THE OPEN GROW OUT INTO BRANCHES

FIG. 1B.

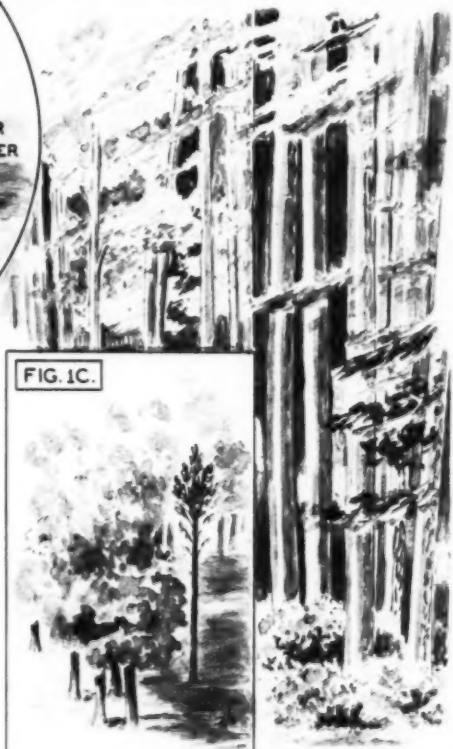


FIG. 1C.

SHADED CEDARS GROW STRAIGHT

GOOD TIMBER

FIG. 1A.

by J. Modrock

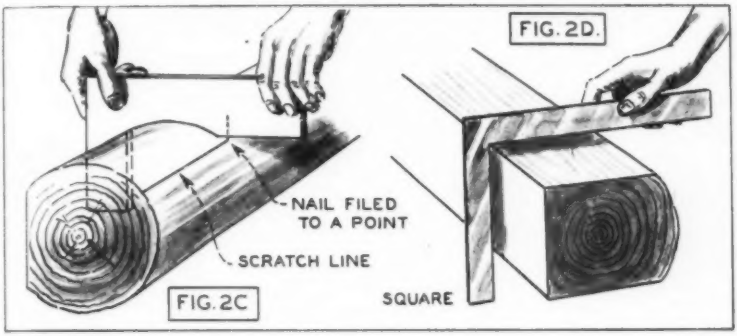
IN WAR-TIME, home owners who plan to make certain repairs to their out-buildings and garden projects may find that suitable lumber is hard to get. Even if it is available, they are reluctant to pay the war-time prices lumber dealers are obliged to charge.

They realize, nevertheless, that essential repairs must be made. They know, for example, that a rotted sill in their tool shed, barn or garage is likely to cause serious structural settlement unless replaced. They know it is unsafe to put off replacing a weather-weakened beam from which the children's playground swing is hung, and that a decayed post of a garden arbor might cause the structure to collapse and injure someone.

FIG. 1D.

Timber that is well suited for making repairs such as these, stands in many countryside woods. It is sometimes cut down for cord wood, but often is left to fall and rot.

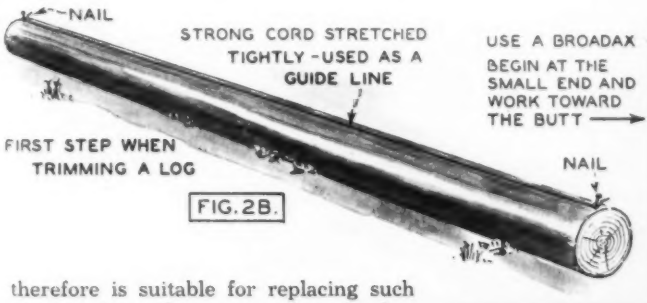
ROUGH TIMBER

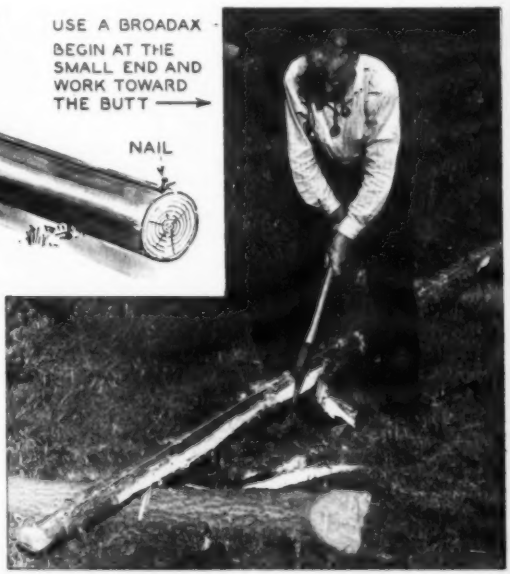


Those who have access to such timber will find it profitable to look it over with the idea of using it for their repair jobs. Here are several suggestions on how to select suitable trees for this purpose; and ways to work the rough timber.

Chestnut, white oak, cedar, pine, hemlock and larch are desirable trees from the lumber standpoint. Two or more of them most likely can be found growing in your locality. Their wood is capable of withstanding ground dampness for long periods and may be dead and dry and even slightly wormy, but the lumber sound enough to use. White oak is the best where strength is the main object.

Cedar, however, offers the greater strength

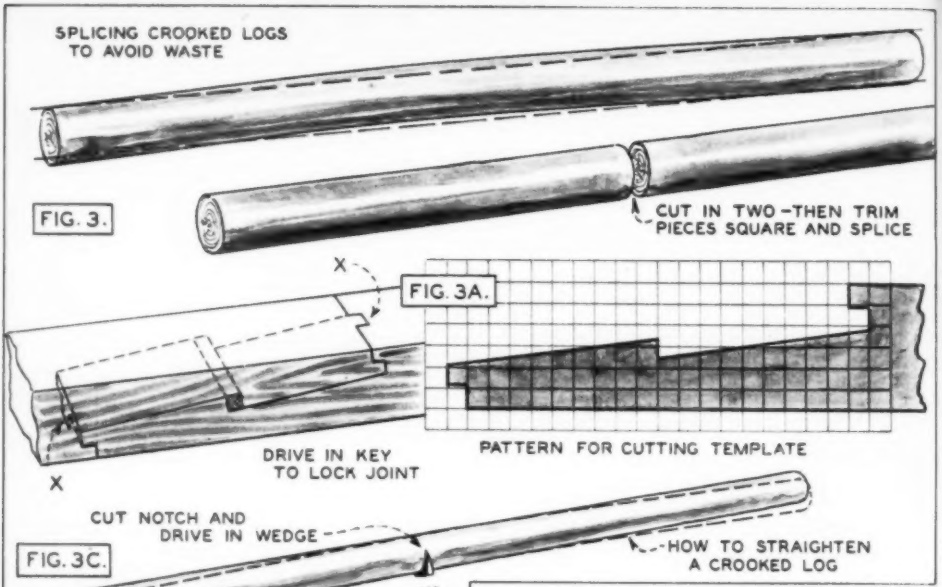


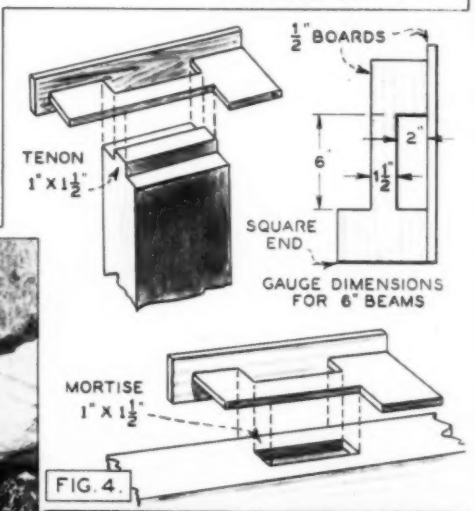


therefore is suitable for replacing such structural members as porch and arbor posts, bridge beams over culverts and streams, and foundation sills. It should be made termite-proof if possible, however.

In addition, it is good for all outside repairs above the ground line such as railings, rafters, studding, and lawn furniture.

In the matter of choice, chestnut is the best for most repairs. It withstands decay to such an extent that a tree





for its weight and is therefore preferable where lightness is a factor. Make sure you do not confuse the white oak with the numerous other species of oak, some of which, like the black oak, red oak, and chestnut oak, produce poor wood for exterior building purposes. Beams cut from them rot in a few years if exposed to moisture. Larch, if of the swamp variety, is the least desirable

FIG. 5.

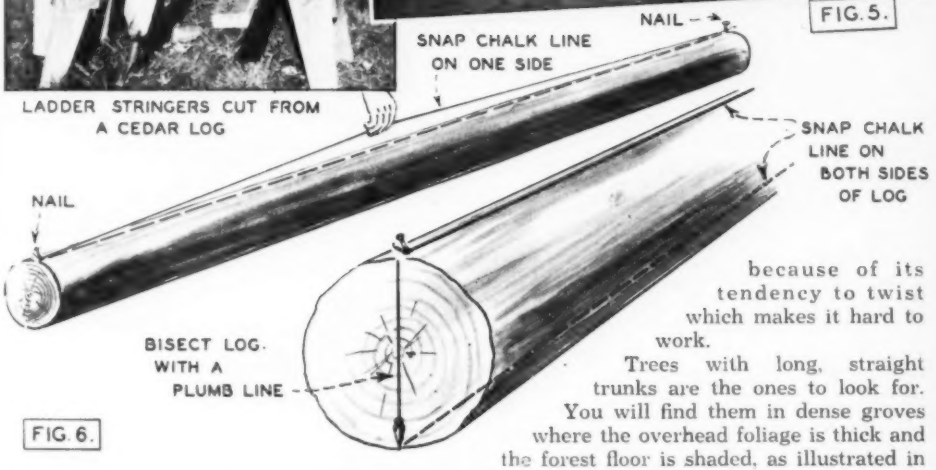
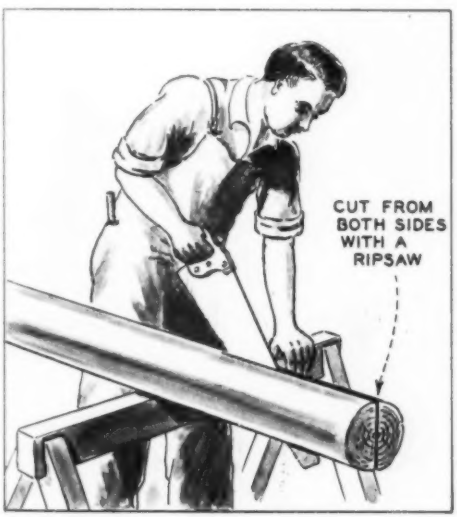

NAIL
SNAP CHALK LINE ON ONE SIDE
LADDER STRINGERS CUT FROM A CEDAR LOG
SNAP CHALK LINE ON BOTH SIDES OF LOG
NAIL
BISECT LOG WITH A PLUMB LINE

FIG. 6.



because of its tendency to twist which makes it hard to work.

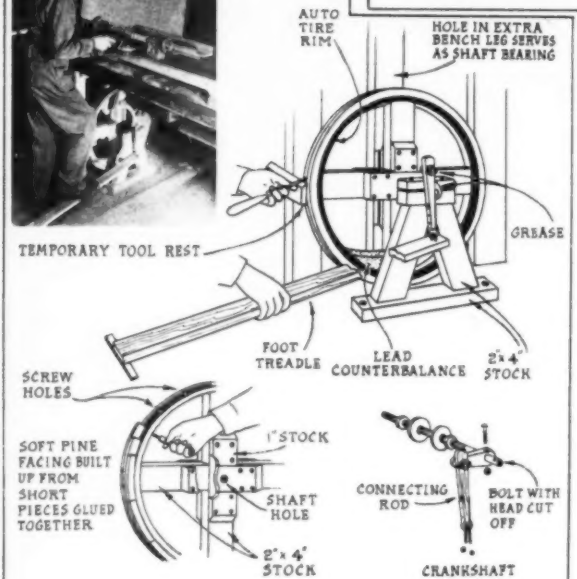
Trees with long, straight trunks are the ones to look for. You will find them in dense groves where the overhead foliage is thick and the forest floor is shaded, as illustrated in Fig. 1A. Unlike trees found in the open (Fig. 1B) which are free to grow out into branches, those in a grove must reach up for the sunlight. Thus they develop large crowns and have trunks that are long and almost free of branches.

Cedar trees of columnar growth should be sought in spots which are conducive to twist-free growth (Fig. 1C). This calls for practically complete shade since it is the daily reaching of the foliage toward the sun as it travels across the sky from east to west that pulls the trunk around, causing it to grow twisted (Fig. 1D).

Determine the straightness of a tree by sighting up from the base of the trunk on all sides. To sight up from only one side might deceive you. It might give you an illusion of straightness when the tree actually is crooked. Therefore check it all around.

After selecting and felling a tree, trim off the crown branches [*Continued on page* 132]

LATHE KINKS



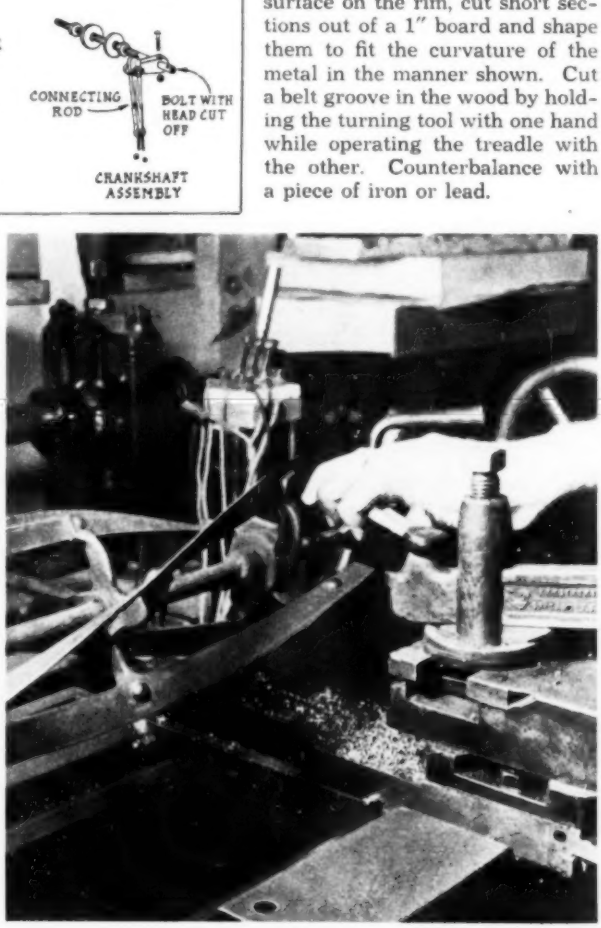
Foot-Treadle Drive For Wood Lathe

FOR use in workshops located in barns, summer cottages and other places without electric current, this foot-treadle drive will operate a small wood-turning lathe with surprising satisfaction.

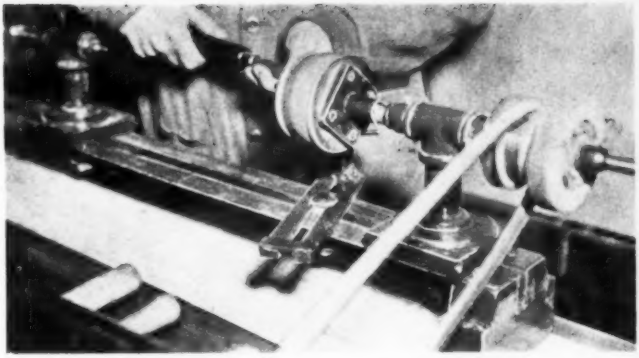
Use a discarded tire rim as the rim of the driving pulley and construct the remainder of the unit from odds and ends of scrap parts. To build up the wooden pulley surface on the rim, cut short sections out of a 1" board and shape them to fit the curvature of the metal in the manner shown. Cut a belt groove in the wood by holding the turning tool with one hand while operating the treadle with the other. Counterbalance with a piece of iron or lead.

Sharpen Lawn Mower Blades On Lathe

HERE is a very simple kink with which most lathe owners are not familiar. Try it some time just before you lose your temper when you've already lost a gallon of perspiration over the front lawn and the grass still stands almost as tall and defiant as ever. Simply take out the lawn mower blades and give them the once-over on your lathe. You can sharpen them very easily by turning and you will eliminate all the laborious hand filing and grinding. Simply mount the blade shaft between centers or in a chuck with the free end of the shaft held true by a tailstock center, and take a light chip with the lathe running at a fairly slow speed. Except for the possible removal of a burr edge, no further treatment is needed.

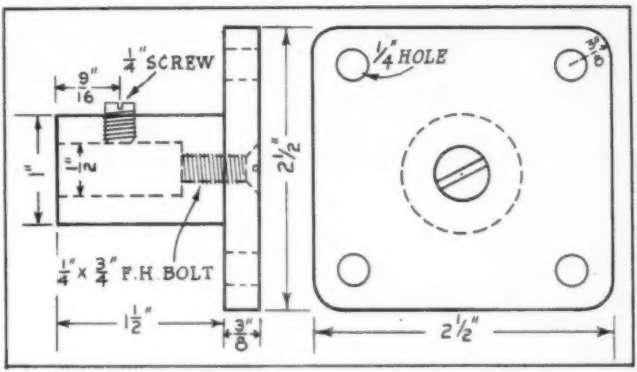


Face Plate Is Easy To Make



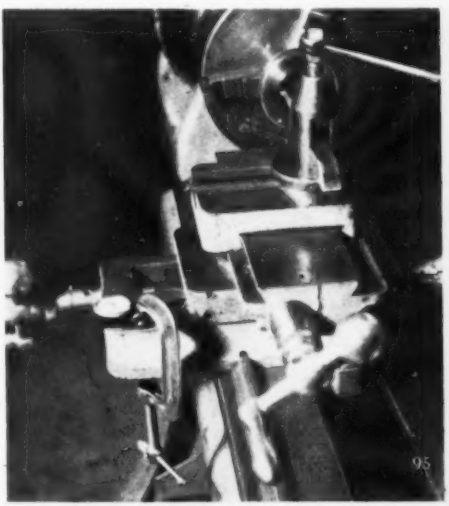
A FACE plate for a lathe can be made easily as shown in the accompanying drawing. The two pieces are cut from ⅜"x2½" band iron and 1" round iron. The piece of band iron is first cut to shape and drilled. The center hole is made with a $\frac{7}{32}$" drill and the hole is countersunk with a ½" drill. It is then threaded with a ¼" tap.

The faces of the round iron must be sawed and ground squarely across. In one end a $\frac{7}{32}$" hole is drilled a little over ½" deep and threaded with ¼" tap. The ¼"x¾" flat head stove bolt is used to attach the two pieces. The ½" hole for the lathe shaft is then drilled on the drill press. Drill and tap the hole for set screws, and face plate is ready for use.



Dial Indicator For Precision Work

YOU'LL run into many lathe jobs where the accuracy required makes it inadvisable to trust the gradations on the feed screw dials. A dial indicator clamped to the compound rest on small lathes or to the apron on large lathes makes it possible to accurately bore and face identical parts. Set tool in position for finish boring of first part. Clamp dial to rest against slide and set to zero. Use this position for finish cut on the next pieces.



This fence is made of sycamore saplings with bark remaining.

Weathered split rails make a practical fence for the farm.

Fences and Trellises you can make

They are attractive and practical and no priorities are necessary.

by Hi Sibley

THE four fences and the wall described here are very easily constructed and the necessary materials are available in nearly all localities. Each has merit in its own setting. The pillar trellises, if not overdone and made too elaborate, will do much to improve the appearance of a simple marquee or plain porch.

The log fence illustrated in Fig. 1A is a copy of the old stake-and-rider or "serpentine" fence which will remind every farmer of his boyhood days in the "wide open spaces." It is made of 6′ or 7′ seasoned saplings approximately 4″ in diameter. They are laid on short staggered posts and secured with lag screws. Another good fence for the farm which will effectually protect the house-lawn and shrubs from wandering livestock is the split rail fence illustrated in Fig. 1B. The split rails are weathered and fastened to posts of the same material by means of large hardwood pegs. This type fence is suitable also

The high "beanpole" fence *below* will insure complete privacy.

A wall faced with broken cement sidewalk is very substantial.

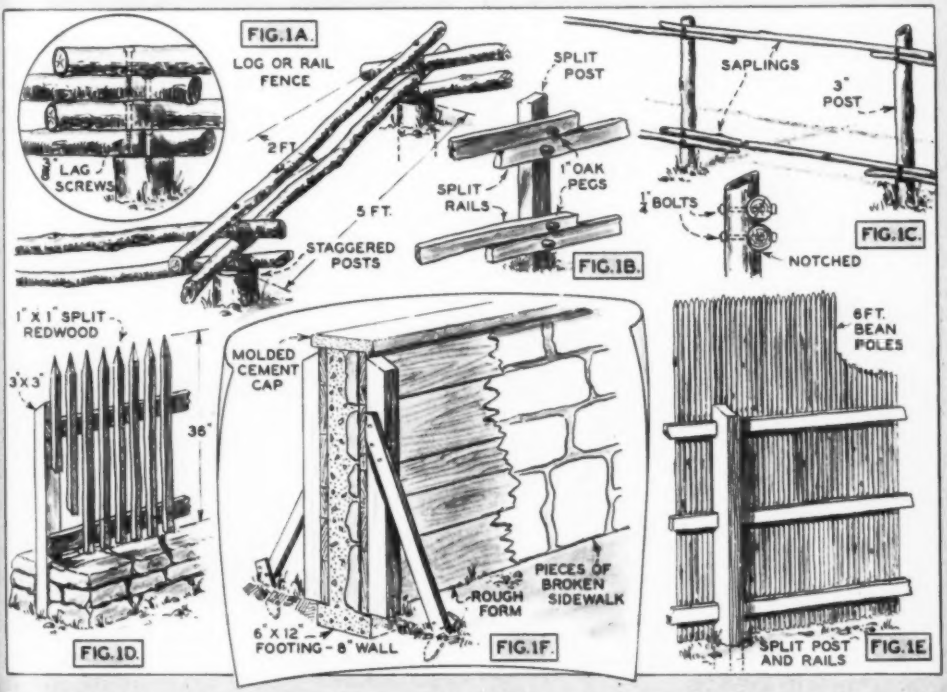
Stripped and whitewashed saplings make a pleasant effect.

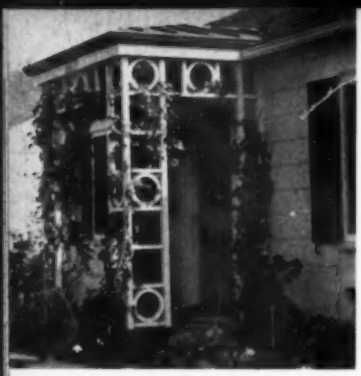
The tight stake fence is one of the more popular types.

for the suburban home. A similar type of rustic fence is shown in Fig. 1C. It is made of light, unpeeled saplings which are set in notched posts and held in position by means of ¼" bolts. Saplings may be stripped of their bark and painted if a different effect is desired.

For complete privacy the high "beanpole" fence is recommended. Its construction is shown in Fig. 1E. Effort should be made to have the rough posts and rails as straight and square as possible for a neat job. The tight stake fence of Fig. 1D is an extremely popular one. It is constructed of split redwood pickets nailed closely together as indicated.

A very substantial as well as attractive wall can be formed by the use of a concrete back and a facing of pieces of broken cement sidewalk. The wall should be capped with molded cement blocks about 2" thick. Use some old scrap bars or discarded heavy wire fencing for reinforcement if any is available, and remember to set your wall on a concrete footing.

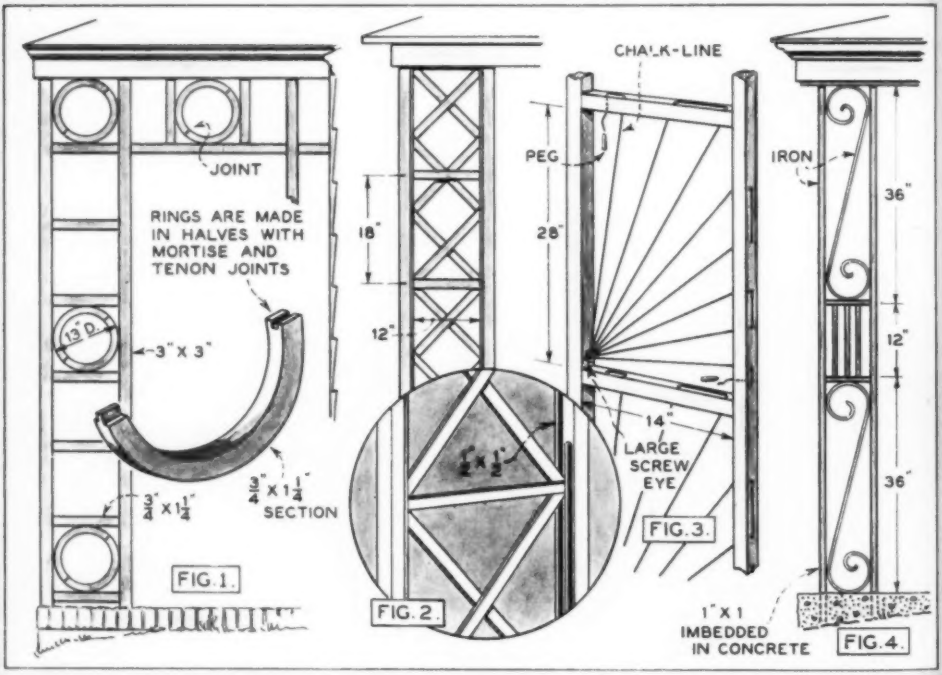




The wooden trellis at the *left* is very attractive. Smaller circles may be used for a lower porch. The small fence blends with the lattice trellis shown above.

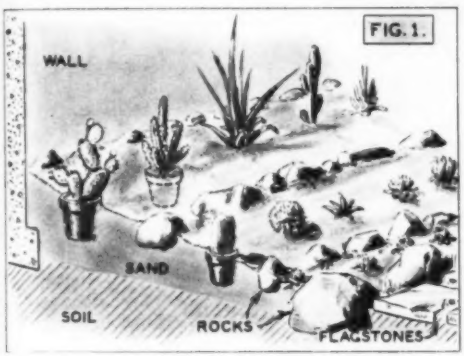
The trellises shown in the photographs and in the drawing are simple in design. A nice effect is achieved in Fig. 2 with the diamond lattice pattern of light battens placed between strips nailed to the posts. A novel arrangement for the beach home is shown in Fig. 3. Chalkline strung tautly on the frame forms the lattice for the vines. The iron pillar of Fig. 4 is something to plan for after the present priorities are relaxed. It is a design well worth keeping in mind till after the war.

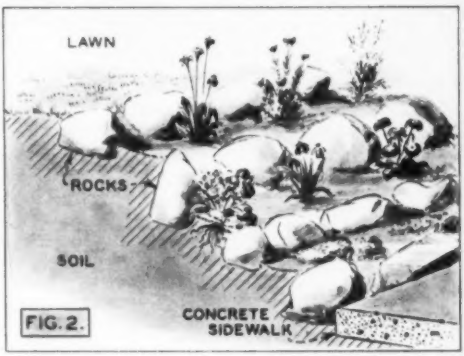
A chalkline forms the lattice for the trellis at the *left*. Iron pillar design at *right* is nice but metal is scarce.



ROCK GARDENS

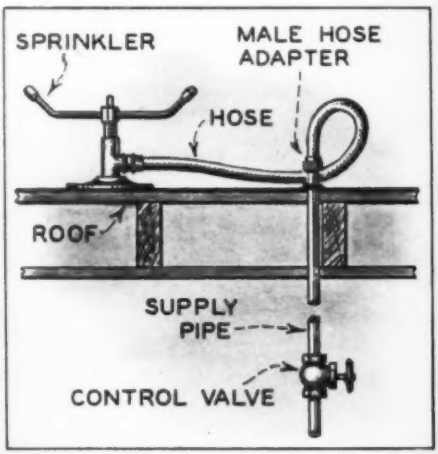
BESIDES making your flower garden more attractive, ordinary rocks and stones can serve a practical purpose as well. A very interesting cactus garden, such as the one shown in Fig. 1, is made by excavating to a depth of 1 foot, making a border of field stone, filling in with sand, making an inner border, filling in again, and so on until the ground is terraced to the wall [*Continued on page* 131]





ROOF SPRINKLER

THE flat roof of a modern dwelling, garage or similarly constructed building exposed to the mid-summer sun can be cooled off quickly at the end of a hot day by operating a lawn sprinkler on the roof top. If a permanent hose connection is installed on the roof as illustrated, only a short length of hose will be needed. It then may be left in place all summer without weather damage. Popular priced sprinklers will cover circular areas ranging from 25 to 50 feet at 35 lbs. pressure. Make sure to use a sprinkler capable of covering the entire roof area.



THE SCHOOL SHOP

Conducted by Gilbert Paust

Ground Instructor and Lieutenant, Civil Air Patrol

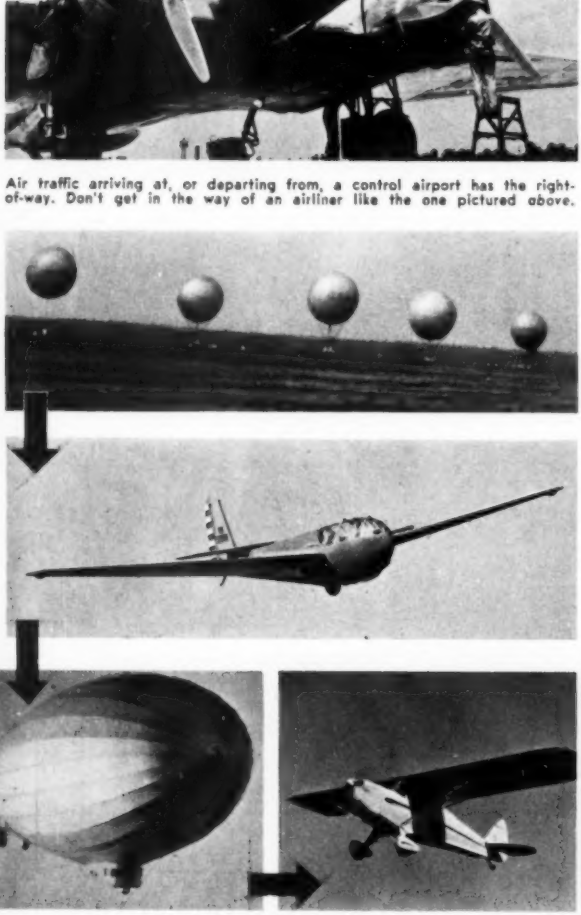
Air traffic arriving at, or departing from, a control airport has the right-of-way. Don't get in the way of an airliner like the one pictured above.

Lesson 6—Air Traffic Rules

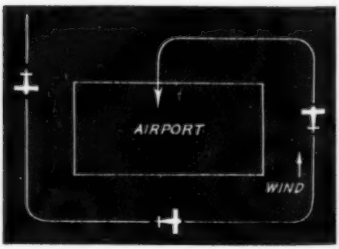
IN THIS lesson we are going to continue with our study of the safety regulations established by the Civil Aeronautics Authority. We are going to alter our original plans a bit, however. We have received so many letters asking us to hurry along to Navigation and Meteorology that we are going to sum up all the Civil Air Regulations this month and tackle our first Navigation lesson next time. Fasten your safety belt and let's go.

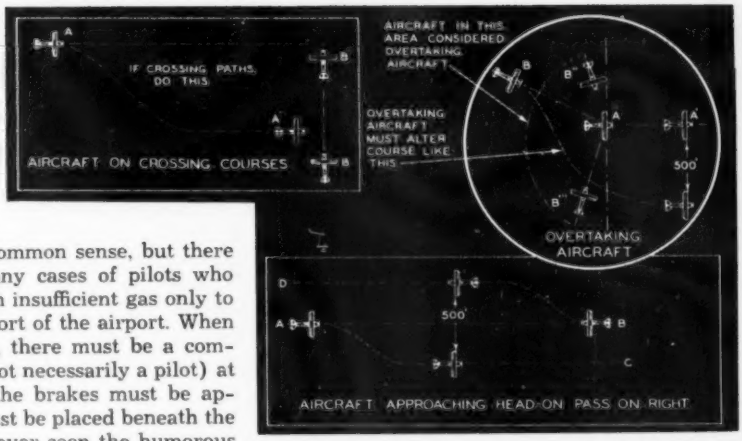
Flight rules are the most important and so we'll consider them first. We'll go over to the airport and take a little spin down the airway and see just what the C.A.A. does and doesn't want us to do.

Arriving at the airport, the first thing we must do is file our Aircraft Clearance which was discussed in Lesson 5. After taking our plane from the hangar, we must check our gas to see if we have enough to reach our destination. This rule would



The four photos at the *left* show the right-of-way of aircraft in flight. First is the free or fixed balloon (also aircraft in distress), then the glider, airship and airplane (and rotor-plane) in that order. Aircraft approaching an airport must circle to left as *below*.




IF CROSSING PATHS DO THIS
AIRCRAFT ON CROSSING COURSES
AIRCRAFT IN THIS AREA CONSIDERED OVERTAKING AIRCRAFT
OVERTAKING AIRCRAFT MUST ALTER COURSE LIKE THIS
500'
OVERTAKING AIRCRAFT
500'
AIRCRAFT APPROACHING HEAD-ON PASS ON RIGHT

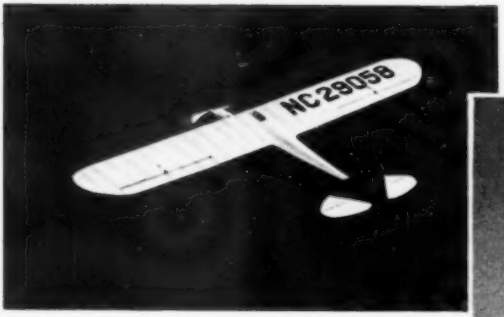
When aircraft are crossing, plane on the right has right-of-way. An aircraft being overtaken by another also has the right-of-way. When aircraft approach head-on, each must alter its course to the right so that they pass at 500 ft.

seem to be pure common sense, but there have been too many cases of pilots who have flown off with insufficient gas only to be forced down short of the airport. When starting the plane, there must be a competent operator (not necessarily a pilot) at the controls and the brakes must be applied or chocks must be placed beneath the wheels. If you've ever seen the humorous but serious spectacle of an empty plane chasing its pilot all over the airport, you'll realize the wisdom of this regulation.

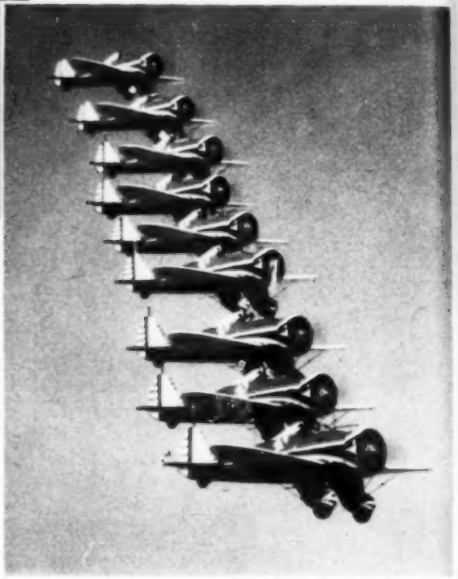
When our engine is warm enough, we can get ready to taxi. If our field has a control tower, we must wait for the operator's radio, light or flag signal before taxiing. With no tower to guide us we taxi to the takeoff position, keeping a careful eye on the other planes both on the ground and overhead. Before giving it the "gun" for the takeoff, we must make certain that there are no planes landing or near. A landing plane always has the right-of-way.

In the air there are definite rules we must follow with respect to other aircraft. An aircraft in distress always has the right-of-way. Next in order is the fixed or free balloon, then the glider, airship and finally the airplane, auto-

These photos illustrate the minimum altitudes of flight of aircraft. Over city, town or congested area: high enough to make a safe emergency landing outside of such area but never less than 1,000 ft. Over open country: not less than 500 ft. Seaplane over water: not less than 300 ft. Exceptions are when the plane is taking off or landing.

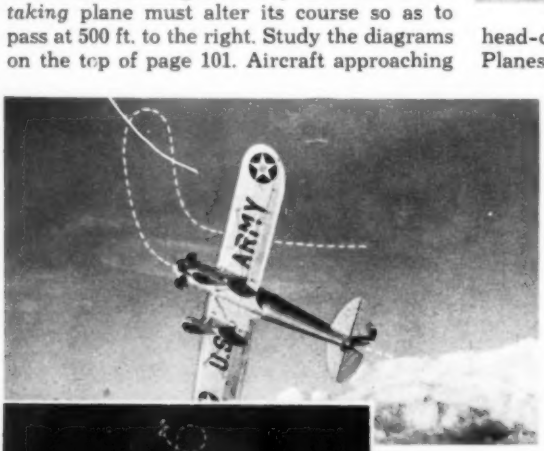


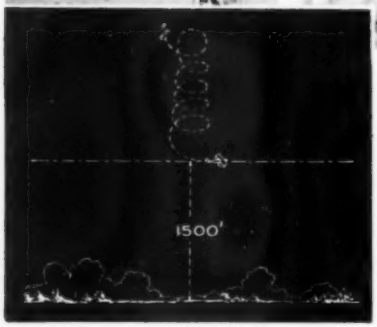
Notice the registration number on the wing of plane at *left*. "N" is national letter for U. S. "C" means fully airworthy. Planes must not fly closer than 500 ft., except by prearrangement or military flight *(right)*.



gyro and helicopter. Examining this list closely you will see that the order is determined by the degree of maneuverability of the aircraft. Balloons and aircraft in distress are the least maneuverable; airplanes, autogyros and helicopters are the most maneuverable. If our course is crossed by another plane, the one on the right (having the other on its left) has the right-of-way, and the other plane which does not have the right-of-way must alter its course so as to pass 500 ft. to the right. When one plane is overtaking another, the plane being *overtaken* has the right-of-way and the *overtaking* plane must alter its course so as to pass at 500 ft. to the right. Study the diagrams on the top of page 101. Aircraft approaching head-on must pass 500 ft. to the right, also. Planes in flight must not fly closer than 500 ft. except by prearrangement or military planes in formation flight.

Now for our minimum altitudes. Over a congested area or danger area, we must fly high enough to be able to make a safe emergency





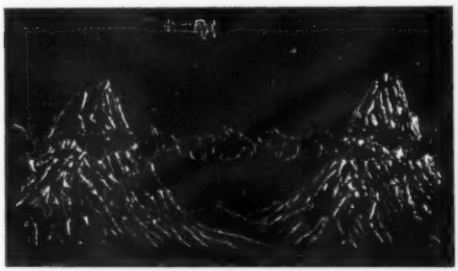
The C.A.A. rules for acrobatic flight are strictly enforced. The army pilot in the Ryan Trainer *above* is executing a wingover. Every pilot must wear a parachute when performing acrobatics. All maneuvers must be completed at 1,500 ft., as at *left*.

Applicants for pilot certificates must take depth perception test shown *at left*. Narcotics may be carried in a plane when needed for a patient under supervision of a doctor or a nurse as in photo *above*.

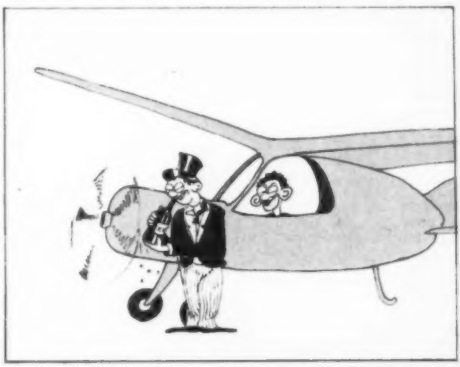
landing outside of that area in case of engine failure, but never less than 1,000 ft. Over open country we can go as low as 500 ft. A seaplane over water can come down to 300 ft. We must keep 1,000 ft. above an open air assembly of persons or a federal penal institution, and 500 ft. from any mountain, hill or obstruction to flight.

The maximum safe altitude (and most of us don't have to worry about this) is 17,000 ft. The air above that limit belongs to military ships, the Stratoliner and others equipped for flight in the rarefied atmosphere.

Next let's look at a few definitions. *Ceiling* is the distance from the cloud base to the ground. *Visibility* is the distance toward the horizon at which [*Continued on page* 138]

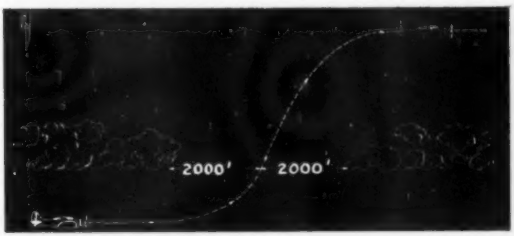


Pilot may fly "contact" above the clouds when the ground is still visible as above. Alcohol and flying don't mix *(below)*.



Planes on contact flight may not be flown closer than 2,000 ft., horizontally to a cloud formation as in the diagram *below*.

Unconfined shot, sand or water may be dropped from an aircraft in flight. Balloons used these materials for ballast.



This U-control gas model is a little brother of the Stinson 105. It uses a ½ h.p. motor and controllable elevators. Its realistic performance is quite amazing.

Build *SKY ROMPER*

fast tether-line model plane

by Robert L. Brown and Bert Bergren

THIS is the ship to satisfy the builder who wants realism as well as performance in his model plane. Its behavior is far superior to most models of this type because of its fast wing design. Its general appearance is that of a Stinson 105, and those spectators who have watched it go through its tricks have been amazed at the aerial exhibition it can offer—a real one-plane air meet.

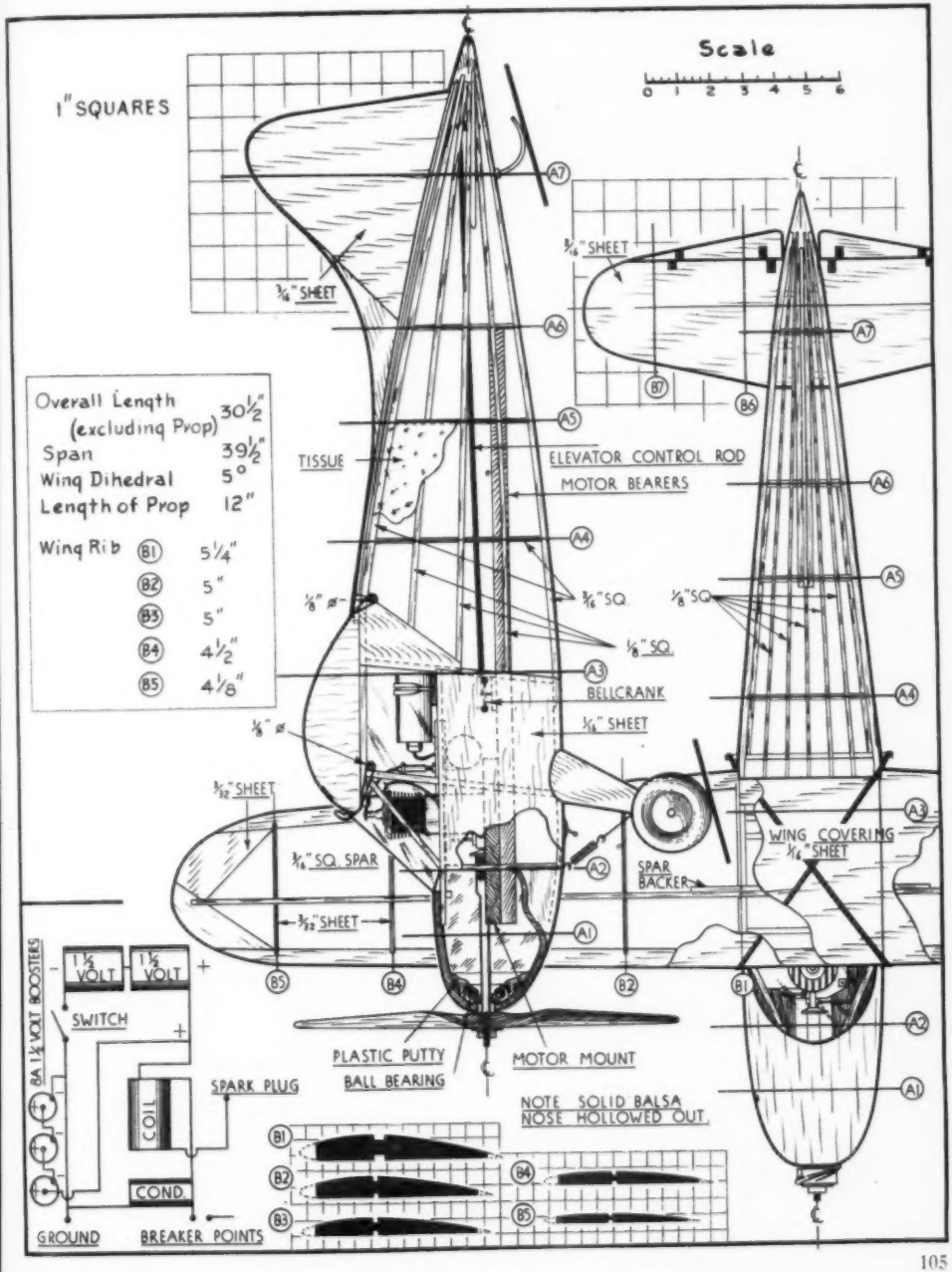
The extension shaft allows complete conformity to scale and facilitates easy starting as well as smooth running. There are no "bugs" in this shaft design. It does not wear out the engine bearings, and it runs the engine faster due to the flywheel action. In case of a crash, the extension shaft helps to save the engine from serious damage, also.

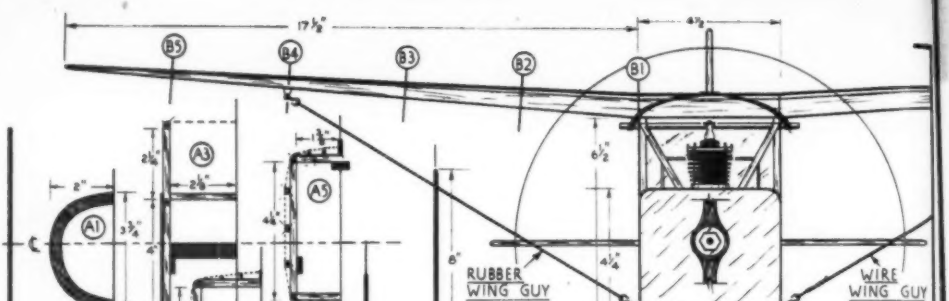
Basswood or white pine will make a good, strong frame. The two sides of the fuselage are constructed first. Make one side and then build the second side over it to insure uniformness of shape. Glue and pin into position the crosspieces, starting from the rear. Use rubber bands or string to keep the two side pieces from springing apart while glue is drying. Glue on the formers in their respective positions and build up a nose block using as many pieces as are necessary to meet

The extension shaft for the propeller enables plane to be built on a scale design and protects engine.

the required dimensions. Hold the pieces in a clamp after gluing them together and saw out the block. Shape it with a knife, check with templates and sand to a smooth finish. Install engine bearers.

For the extension shaft, secure a piece of $\frac{3}{8}$" round stock steel. Thread one end and drill and tap the other. Slide on a ball bearing at the front, and screw this shaft on the $\frac{1}{5}$-horsepower engine shaft. Slip on the nose





This diagram shows the details and dimensions of the fuselage formers and the positions of the wing ribs.

block and hold the bearing in place with plastic putty or wood. If this is carefully worked in around the bearing to act as a seat; the shaft will be perfectly in line with the engine and will have no vibration or whip. Besides retaining the desired effect of realism, the extension shaft makes possible a smoother running engine with greater rpm. Glue the bell crank base in place and install the bell crank. Fill the nose block with a good wood filler. This greatly increases the strength of the nose as well as making possible a fine finish.

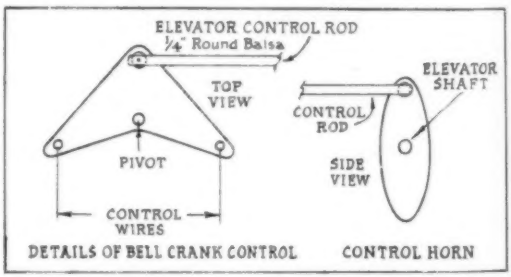
Glue in the mount for the coil and batteries, and hold the batteries in place with rubber bands. If parts of the wiring are difficult to install, leave these parts uncovered until later. Install the two main wires of the landing gear together with the spreader wire and spring. The stabilizer must be installed before covering with cloth, because the control horn is concealed inside of the body. The hinges of the elevators are of cloth tape. The rudder, like the stabilizer, is made of sheet balsa glued securely. Adjust the rudder to pull against the control lines when assembled. Cover the rear of the fuselage with silk or tissue.

Glue the spars to the wing ribs, attach the leading and trailing edges and glue on the top and bottom sheet coverings. Rig up the wire wing struts on the left wing and the rubber band struts for the right wing. Put a wire guide loop on the left wing wire strut.

You may paint your model as you choose. Slide the control wires through the wing strut guide. Attach 52′ 6″ lines or 70′ lines of fish cord, if no piano wire is available, to the wires and to a simple handle. The ship flies in a clockwise circle when seen from below. Use your right hand to hold the lines and adjust the elevators by moving the handle. Test-fly your ship when there is no wind. If you've never flown a U-control job before, you'd better not have the engine running too fast, or you'll get dizzy. Another thing to remember is that only the slightest movement of the control handle is necessary for ordinary flying. Don't overcontrol your ship! Only in a loop or dive is all the control needed.

Let your model take off from the ground: don't launch it from your hand. Incidentally, choose a nice, level area for your performance, and don't let the spectators crowd in too close.

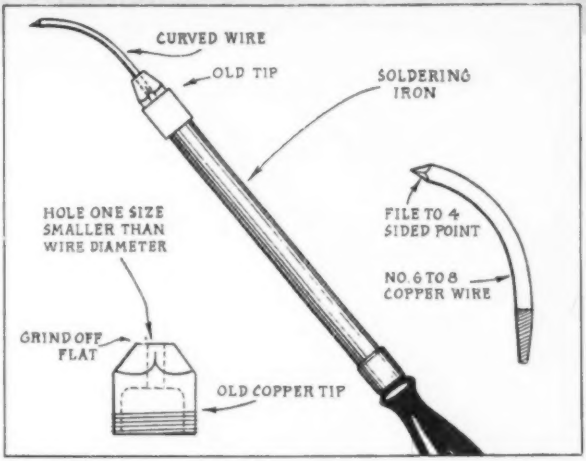
Top view of bell crank and side view of elevator horn.

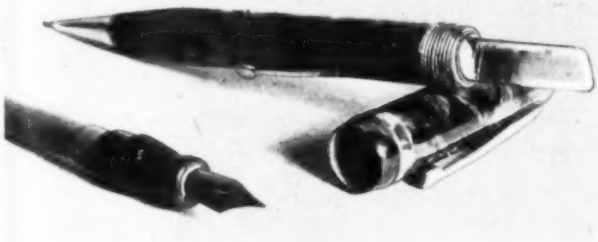


Methods For Model Makers

Soldering Iron For Delicate Metal Work

A CRAFTSMAN who did all the delicate metal work on model boats was called upon to construct several masts of small brass rod, No. 30 wire and similar material. No ordinary soldering iron was small enough and the work would not stand even the finest needle flame, so he transformed an ordinary electric soldering iron into an instrument that did the work beautifully. In fact [*Continued on page* 144]



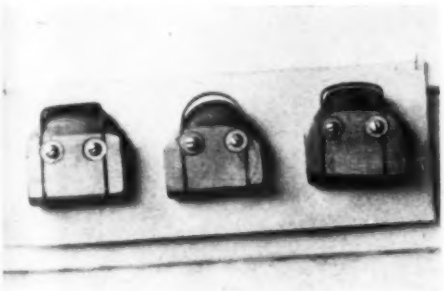


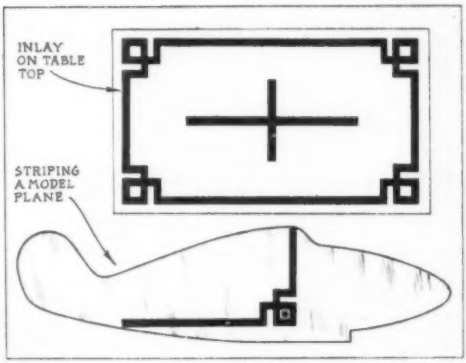
Combination Knife And Pencil Tool

THIS handy tool can be made from an old pen-pencil combination. Remove the pen part and insert a split dowel plug in the tube. Small blades from an injector-type razor may be ground to any desired shape and placed in the plug.

Scotch Tape For Stripes

PAINTING a stripe on a model plane or any irregular surface is not an easy job. Scotch tape, however, can be used instead of paint as at right, and the results are excellent. Cut tape to desired width. Tape may be used also for an inlay effect on wood. Lacquer the design, sandpaper and lacquer again.





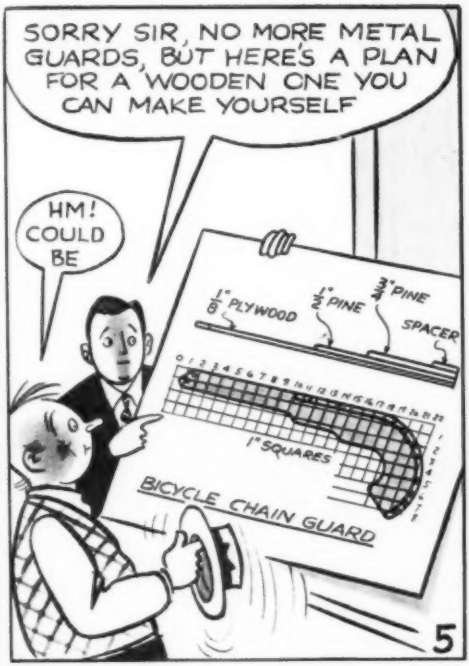
Gouges For Model Boats

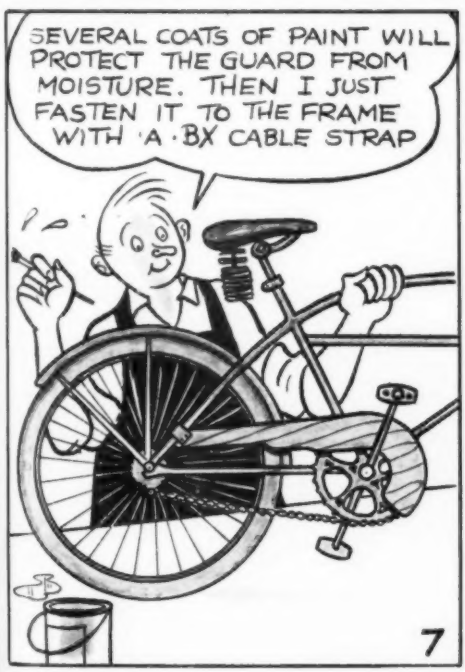
THESE gouges or "planes" simplify the task of digging out the hulls of "bread-and-butter" model yachts. The bodies of the planes are made of [*Continued on page* 131]

—A Bicycle

... BUT YOU LOOK S-W-E-E-T, UPON A S-E-A-T, OF A BICYCLE, B-I-L-T, FOR T-W-0-0-0
ERAL STORE
RIP
1
!?@?*-!! WHAT'S THIS? SABOTAGE
2
DONT YOU KNOW YOU SHOULD HAVE A CHAIN GUARD ON YOUR BIKE, MISTER?
YOU DON'T SAY!
3
NO MORE RIDING FOR ME, BEFORE I DO. I'LL GET A NICE SHINY CHROME ONE TOO...
I'LL BRING YER STUFF HOME, MISTER BILDIT
4

Built For Bill Bildit





CUT METALS THE EASY WAY

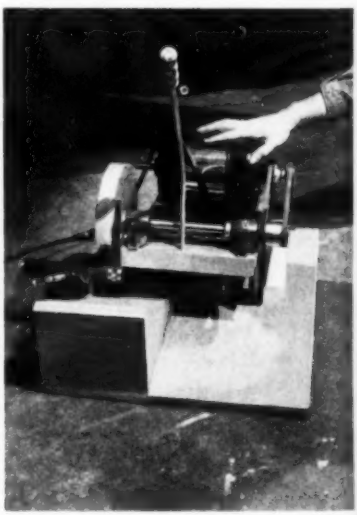
Here's an inexpensive homemade power tool that your workshop cannot afford to be without.

by
Ray Schneider

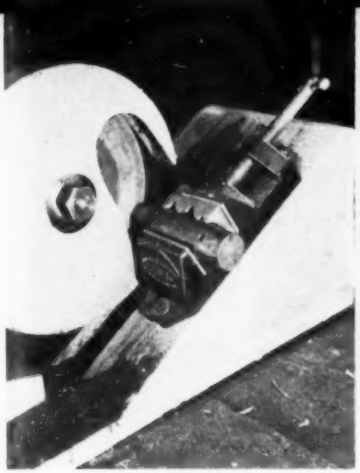
Steel, brass and other metals, as well as glass rods and tubing can be cut in a jiffy with this high-speed abrasive cutting machine.

THERE is probably nothing more discouraging to the home workshopper than to have to hack his way, by hand, through a tough piece of metal to the tune of dull and broken hacksaw blades and aching muscles. I know, because I have had the experience and as a result have developed this easily constructed carborundum cut-off machine, the operation of which would delight the heart of the most particular hobbyist. Some of its outstanding features are: ability to cut any metal from case hardened steel to soft brass; ease of operation and speed with which a true clean cut can be produced. In regard to speed, this apparatus is really tops. It's not just two or three times as fast as hand cutting, but ten or twenty times as fast. I can personally guarantee that regardless of how good you think it sounds on paper, you'll be agreeably surprised and pleased with its superb performance under actual working conditions.

While machines of this type are on the market under various trade names such as:



Left: Back view, showing work clamped in a Sears-Roebuck drill press vise. Motor table and disk assembly tilt forward by means of convenient handle. *Right:* Motor of ½ horsepower drives the abrasive wheel through a twin belt transmission. This prevents slippage and permits the use of added power.



Left: Closeup of metal bar being cut, while clamped in vise. Wheel will cut through a ½" steel bar in 15 seconds. *Right:* General assembly view. Compare this with drawing below to get a clear idea of how the cutter is constructed.

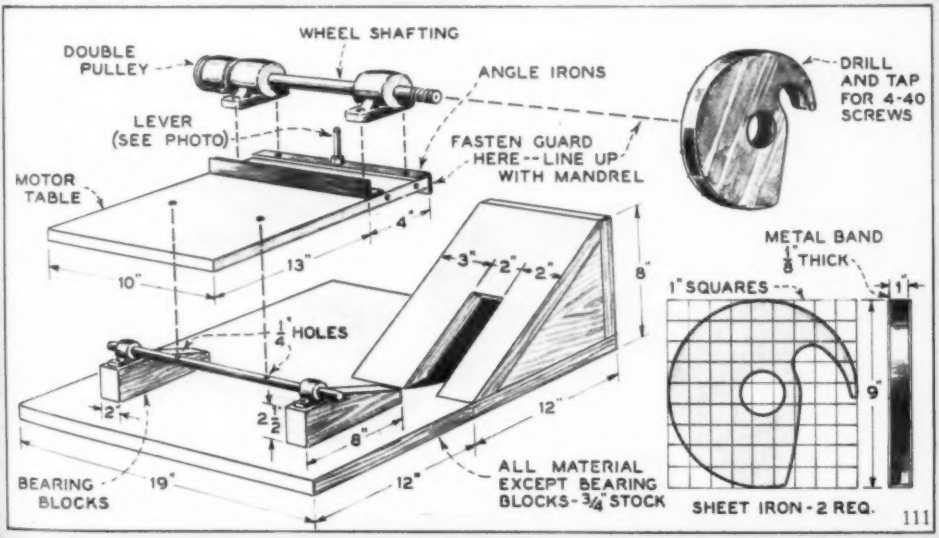
"Abrasaw," "Abrasion Cut-Off Machine," etc., it is obviously impossible to obtain one without a very good priority rating. It is equally obvious that no shop is complete without some type of power operated metal cutting equipment. The solution, therefore, is to build this handy machine and at the same time make future shop projects that much easier.

A list of parts follows:

1—Mandrel
2—3½" V belt pulleys
2—V belts
1—Drill press vise
2—2" V belt pulleys for mandrel (if necessary)
2—½" babbitt bearings
1—18" length of ½" shafting
1—Motor
2—Thrust collars ½"
Several lengths of hard wood board, assorted bolts and screws

All the required parts, with the exception of the motor, can be bought at Sears-Roebuck without a priority, and the motor, if your shop doesn't sport a spare one, can be obtained from a second hand motor shop.

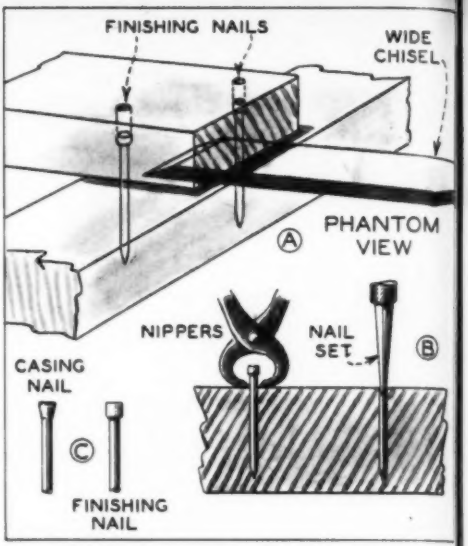
The first step in the actual construction of this machine is the building up of the basic framework. This has been made entirely of wood, and any hard wood such as oak is very satisfactory. The individual parts are screwed together and being of wood tend to absorb and dampen sound and vibration caused by cutting. The tilting motor table is bolted to a shaft after the holes are drilled through the shaft as shown. Bearings are then slipped over ends of the shaft and screwed down upon bearing blocks. The front edge of the tilting table, in order to provide additional rigidity and strength, has [*Continued on page* 144]

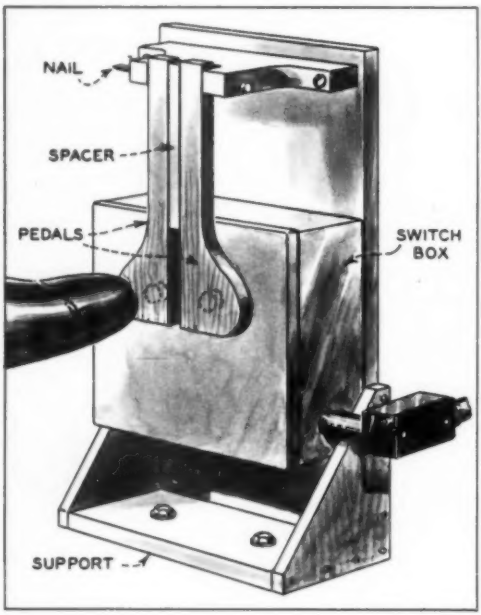


SHOP KINKS

The Proper Nail Saves Wood

WOOD for temporary cabinet work can be used again if the proper nails are selected the first time. Use finishing nails on hard wood, and casing nails on soft wood (C). Pry work apart with chisel (A) pulling nail heads through. Then nip heads, and sink nails as at (B).



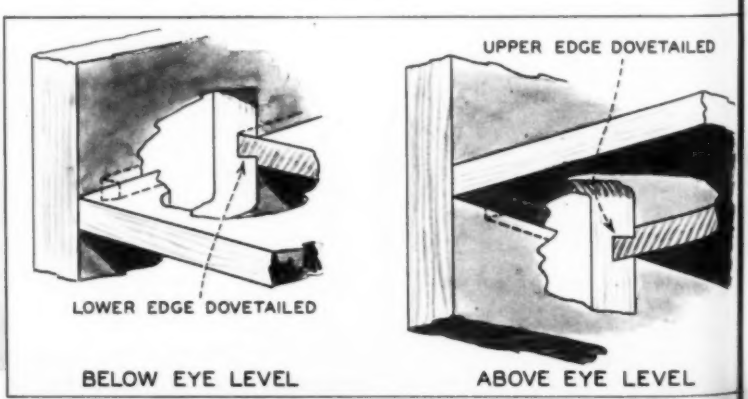


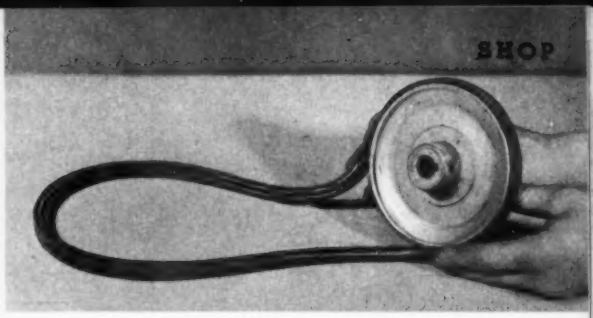
Pedal Operated Switch Speeds Machine Work

THIS simple foot switch (left) can easily be built around an ordinary switch box. The box should be mounted within easy toe reach. The wooden pedals can be lifted when work is to be done on the box. One pedal covers "on" button, other covers "off".

Concealing Dovetails

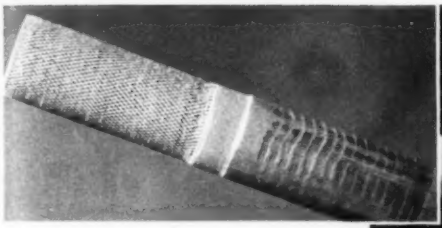
AMATEUR or hasty dovetail jobs sometimes show an open seam where the imperfect fit of the dovetail runs. Avoid this crude appearance by using one-sided dovetails, arranged as shown, with regard to eye level. The right-angle joint seam will be snug.

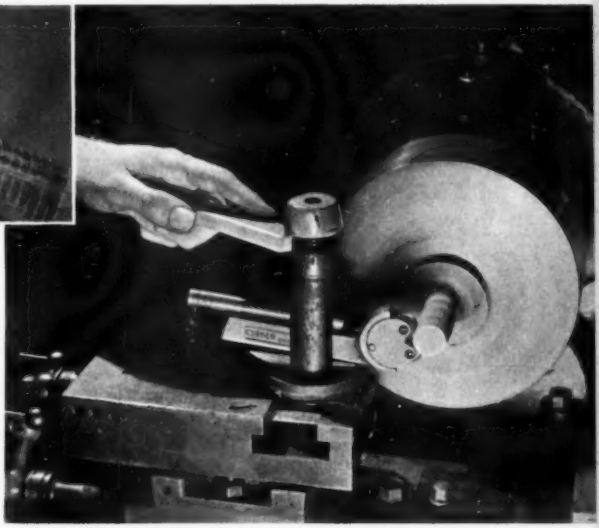




Emergency Motor Belt

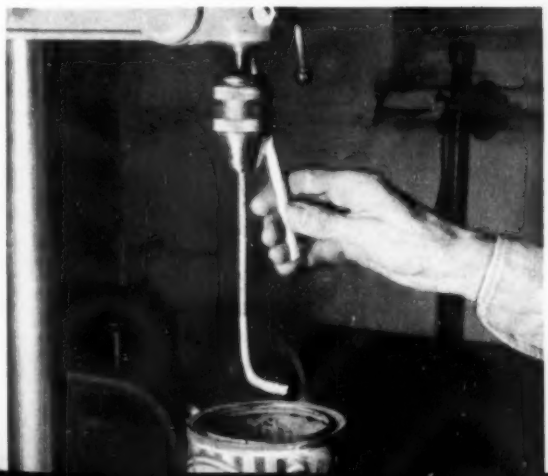
THE belt on a fractional horse power motor may suddenly break or become worn and a new one of the same kind may not be available. In this case, an old auto fan belt of the same length can be cut down in width as shown above, left. If carefully done, the resulting belt will be found to answer perfectly. A block of wood with a strip nailed on for a side is clamped in a vise. Cut is made with a sharp knife.





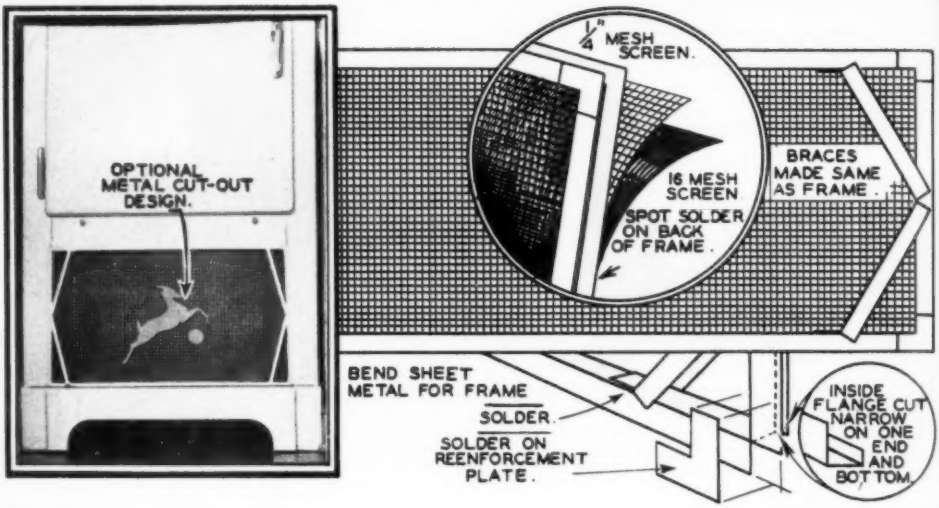
Knurling Wood

DID you know that wood can be knurled as readily as metal? This makes possible an unusual decorative treatment of turned objects such as candlesticks. Chuck the wood in the lathe and use a knurling tool in the customary manner. You can take deeper "cuts" than with metal, and two or three passes, or sometimes just one, are sufficient. After removing the work from the lathe, brush the knurled area and apply the desired finish.



Drill-Press Stirring

PAINT or other liquid can be stirred efficiently by a drill press having, in its chuck, a paddle consisting of a ¼" rod with the lower end bent at right angles. Splattering is eliminated by starting and stopping the motor while the rod end is immersed. If there is much stirring to do, some sort of hold-down arrangement for the paint cans or other containers should be provided. Another form of paddle consists of a rod with a hexagon button (the head of a large bolt will do) on the lower end. This is similar to the stirrers on milk-shake machines. Don't operate the stirrer in a Jacob's chuck; use the router chuck.—*W. E. B.*

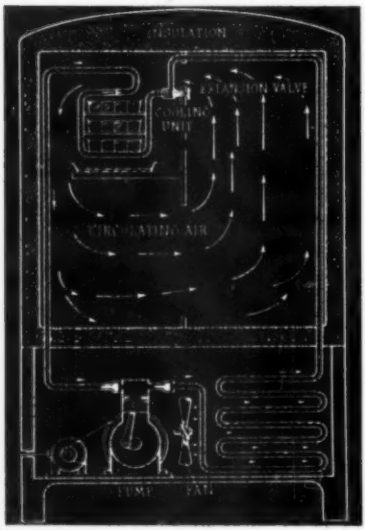

OPTIONAL METAL CUT-OUT DESIGN.
1/4" MESH SCREEN.
16 MESH SCREEN
SPOT SOLDER ON BACK OF FRAME.
BRACES MADE SAME AS FRAME.
BEND SHEET METAL FOR FRAME
SOLDER.
SOLDER ON REENFORCEMENT PLATE.
INSIDE FLANGE CUT NARROW ON ONE END AND BOTTOM.

How To Conserve Your Refrigerator

YOU had better take care of that mechanical refrigerator of yours because that's all there is, there "ain't" no more—at least there won't be any more until the war is over and our country settles down to normal again. Maybe if we take a quick look at the inside of our "icebox" (not at the part which used to hold the juicy steaks and the creamy butter, but the machinery itself), we'll be better able to understand why we must take certain precautions to keep it in good working order.

The diagram below shows the setup. A pump compresses the refrigerant (sulphur dioxide, SO_2, is the gas usually used), which is then sent under pressure through a series of coils where the gas is cooled and liquefied by air circulation through the coils. The compressed and cooled liquid is then allowed to expand as a gas through an expansion valve into the cooling unit of the refrigerator. This expansion causes a considerable drop in temperature to a point below the freezing point of water. You can experience this same cooling effect if you hold your hand over the open valve of an auto tire which has become quite hot after a long drive. The hot gases become cool by expansion through the tire valve stem.

From Fundamentals of Machines, Dull and Nevelin, Henry Holt and Co.



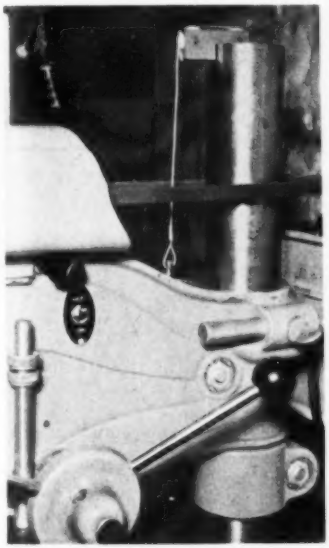
The cold, expanded gas in the cooling unit absorbs the heat from and cools the material within the refrigerator compartment. The gas is then drawn back to the pump and the cycle is repeated. A thermostat or automatic switch operated by temperature controls the degree of cooling which, in turn, depends upon the number of cooling cycles the refrigerant performs. Refrigerators which operate by means of heat supplied by illuminating gas employ essentially the same principle. Heat is used to cause a chemical change which results in a temperature drop at the unit.

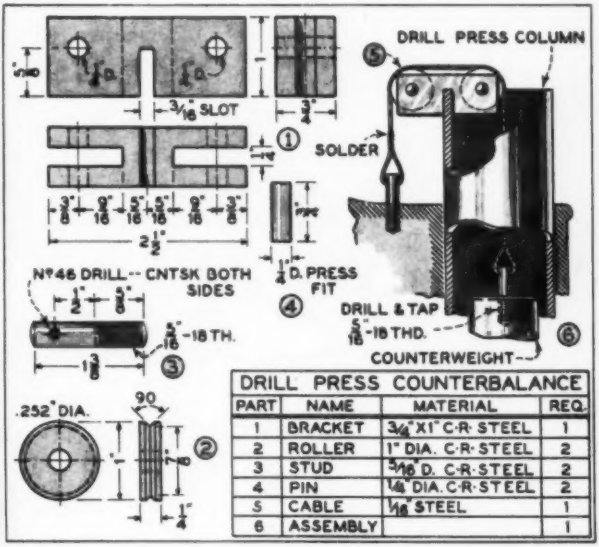
In the former type you can see how important it is to cool the compressed [*Continued on page* 131]

DRILL PRESS COUNTERBALANCE

RAISING and lowering the head of a modern bench drill press is usually a difficult job. This counterbalance arrangement, as shown in the sketch and photograph, will solve the problem for you. The balance is made to travel in the hollow, ground column. Its weight is determined by experiment.

Hole cut in bench below column for weight to drop will allow the drill press head to be raised to its maximum height.





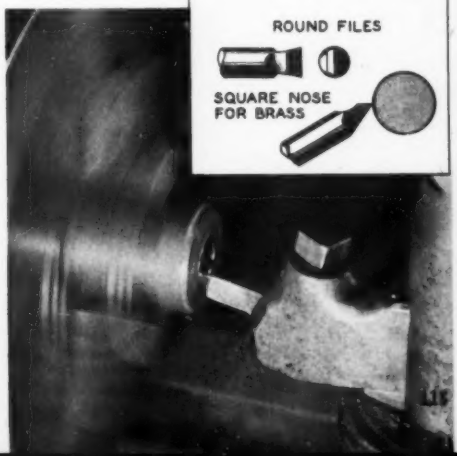
DRILL PRESS COUNTERBALANCE

PART	NAME	MATERIAL	REQ.
1	BRACKET	¾" X 1" C·R· STEEL	1
2	ROLLER	1" DIA. C·R· STEEL	2
3	STUD	3/16" D. C·R· STEEL	2
4	PIN	⅛" DIA. C·R· STEEL	2
5	CABLE	1/16" STEEL	1
6	ASSEMBLY		1

LATHE BITS FROM OLD FILES

TO CONSERVE steel for more important work, lathe bits made from worn-out files can be used for machining steel, brass, fiber, plastics and wood. Square, triangular and round files can be used in standard tool-bit holders.

Grind off file teeth at end to be shaped, then grind the metal to the shape required. In grinding, be careful not to heat the file too much. Temper by heating the finished bit until the polished part turns a straw color and then plunge in water. These bits will hold a very keen edge.



ANTIQUE ENGLISH DUMBWAITER

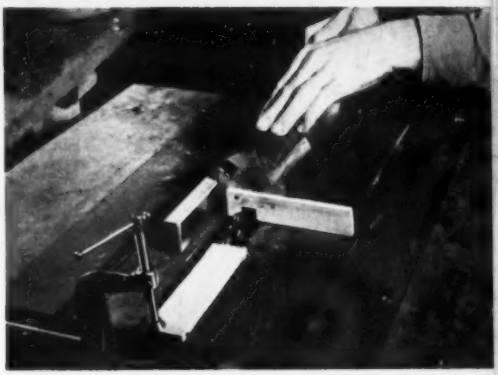
This English dumbwaiter will be an attractive addition to your living room. Use it for serving or as a stand for books and knickknacks, too.

Photo *below* shows stepped tenon being inserted through free-turning brace into top. Note position of hinges and how they fit flush under tier.

The drop-leaf tier is an interesting feature of this model. Free-turning brace under the tier permits leaves to fold.

MOST of us associate the word "dumbwaiter" with a little door set in a kitchen wall, opening upon a shaft through which we are accustomed to lower the refuse of past meals and in return receive all the odors of cooking from the apartments below. Over in dear old England, however, they jolly well have a different meaning for the term. The English dumbwaiter is what we commonly refer to in this country as a "tier-table." It is used for serving drinks, muffins and crumpets to guests of the household or simply as a knickknack stand. This particular model is a copy of an antique design. Its construction is simple.

For the larger tier, rough boards are joined together to make a piece approximately 19¼" square. This square is run through a large planer to ¾" thickness. If a large planer is not available, it can be dressed down by hand. The square is next



Brace for lower tier is cut to shape and fastened with capped dowels as shown *above*. Cleat tacked on bottom of standard as in photo at *upper right* keeps standard from turning when making dadoes. Mortised joint locked with dowels is shown in photo at *right*. Glue legs in position.

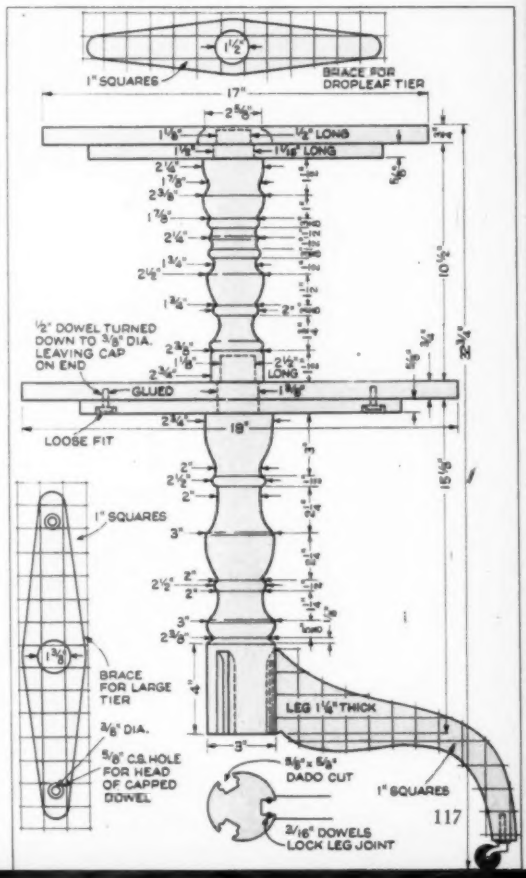
bandsawed to a 19″ circle, the edges are sanded and the hole bored in the center. The brace, cut to shape, is dowelled to the underside of the tier with specially prepared capped dowels. Dowels are glued only at the tip, thus permitting slight swelling and shrinking of the wide tier.

Three pieces are fitted together for the top tier and planed to ¾″ thickness. The joining edges are shaped with drop-leaf cutters on the shaper. Drop-leaf hinges are fitted into depressions cut in the underside. Now the assembled top is bandsawed to 17″ in diameter and the edges sanded thoroughly, after which the hole is bored in the center for the standard tenon. Next prepare the free-turning brace according to the drawing.

Making the legs is a simple bandsawing job. For maximum strength the grain of the legs should run lengthwise. Tenons are cut as indicated and holes are bored for caster shanks. Three white porcelain casters will give the table an old and authentic touch. If you are fortunate, you may be able to find them in some antique or second-hand store.

The standard is turned in two sections. Stepped tenons are turned on the top end of each section. The stepped tenon on the top section (see drawing) is made so the brace of the drop leaf will turn freely. In assembling, the tenon and stepped tenon on the top end of the lower part of the standard go through the hole in the large tier and brace, extending into the hole turned in the lower end of the top section of the standard.

Three dado cuts are made in the lower end of the [*Continued on page* 131]



HOME AIDS

Shaping A Paintbrush

GIVE an inexpensive paintbrush the beveled edge of a more costly one by: dipping brush in glue, letting it harden, shaping with sandpaper and then washing.

String Cutter From Old Razor

A SAFETY razor fastened to a counter, table or wall makes a handy and efficient cutter for string and cord. One way of fastening is to drive staples around the handle. Provision should be made for replacing the blade when necessary. A type of razor having a toothed guard is best.

"Purifying" Air In Room

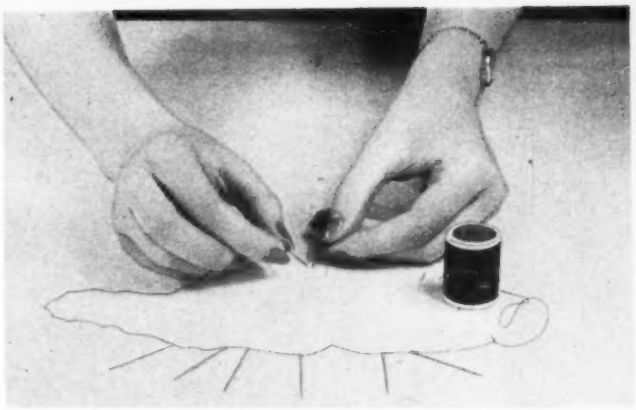
TO ELIMINATE cooking or tobacco odors connect the electric iron and lay it bottom up in a large bowl. Sprinkle cinnamon or nutmeg on the iron and air will sweeten.

One Minute Broom Holder

IT TAKES only a minute to fashion an efficient broom holder (left). Slip a length of rubber tubing over a piece of stiff wire about 7" long, loop in center and fasten to wall by nails through ends.

Saving Time In Quantity Sewing

WHEN there is a lot of sewing to be done, thread several needles on the thread before it is broken from the spool. Each time a new length of thread is needed, select the end needle, pushing the remainder back toward the spool, and break off as much thread as is needed. It will be found that this procedure is quite a time-saver.



Salvaging Sink Stoppers

A BIT of paper cement, a disk of oilcloth and a dash of ingenuity can transform a worn out rubber stopper into one "good as new." Cut the oilcloth to size and cement to top of old stopper, as shown at left.

Decorating Party Glasses

GIVE your party glasses an individual touch by printing names of guests on sides with colored nail polish as below.

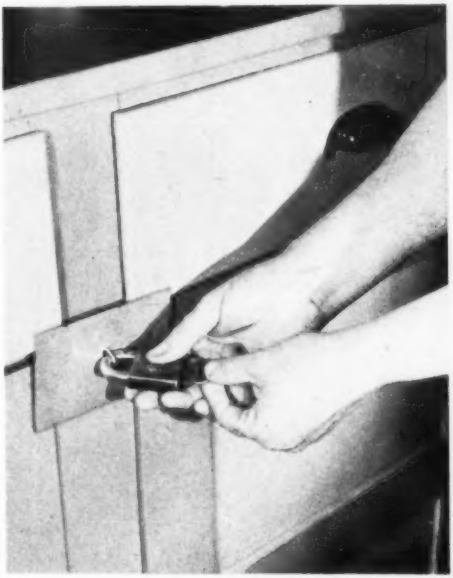


Plate Locks Cupboard

A METAL plate and padlock can be used for locking several cabinet doors or drawers at once. Cut a sheet-metal plate large enough to extend over corners of doors to be secured. Cut slit in plate to receive hasp staple. Use padlock as shown.

NEW FURNITURE FROM OLD

PART IV

The photo above shows the finished vanity fastened to a closet door. It may be hung also on any convenient wall space. It was made from the mirror and supporting arms of the outmoded dresser shown in the photo at the *right*. The conversion was made with simple hand tools.

THE hanging vanity described in this article was made from an old mirror and its two supporting arms. The transformation was simple. First the support of the mirror was knocked apart by means of a mallet. This did not prove difficult as old age and long years in a steam-heated apartment had dried out and weakened the glue.

The long, slim, and gracefully curved members were altered by having their wing-like projections sawed off, the saw cut then being rounded off on a sander to conform to the rest of the piece. These two curved members were fastened together as sides of a shallow box which was made from a small drawer out of one of the old

First the frame was dismembered with a wooden mallet as above. A small box was made and piece between arms was used as lid *(left)*.

This is the final installment of the series on remodeling furniture. Here the authors explain how they made a hanging vanity and a lamp from old pieces.

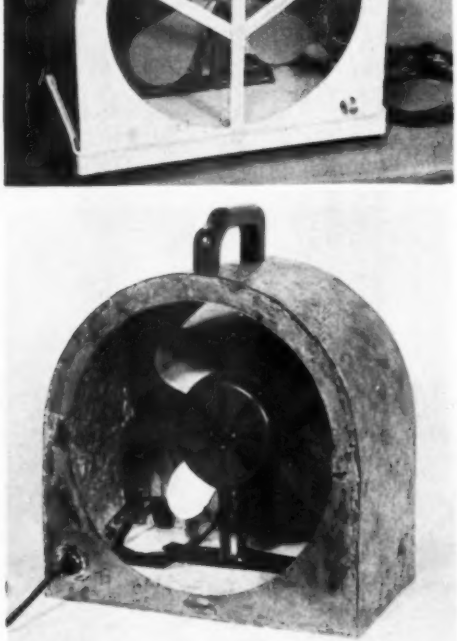
by
Charles and
Bertram Brownold

The attractive table lamp above was made from the discarded table shown at *left*. The table was in very poor condition, scarred quite badly and with one leg missing. A section of vertical member became the lamp post. Base was from another old piece.

pieces of furniture acquired in the original odd lot. In this position the planes of the two curved members were parallel to each other and at right angles to the door to which they were fastened. The piece between the two curved members was used as the lid of the aforementioned box and it was hinged into place after the paint job had been completed as shown in the photo.

A piece of ½" dowel glued into position below the box served as a handy towel rack. [*Continued on page* 142]

When cutting turned section as *below*, make sure plane of saw cut is perpendicular to axis of the section. Notice drilled hole for wire in photo at *lower left*. Fasten the section to base with dowels.



Remodeled fan, attractive, breezy and portable is shown at *top*. Back of the new case *(above)* with the ring removed.

FIX UP THAT OLD FAN!

by Ralph T. Moore

TIME was when the old electric fan with the bent guard and the frayed cable went out with the rest of the "junk," and a new one was purchased to take its place. This year, however, new fan material will be serving just the opposite purpose, that of making it "hot" for the Axis. All this probably won't make the summer one degree cooler and you will still appreciate the pleasure of a cooling breeze. So fix up the old one. Here's how:

First take the old fan apart and clean the motor and fan blades. Discard the guard and the base. From two angle brackets make a new base for the motor as shown in Fig. 1. The height of this bracket should be sufficient to allow the fan blades 1½" or 2" clearance with the base.

Next measure the diameter of the fan blades. To this figure add 2". This will be the diameter referred to in Fig. 1 as "A" diameter. Since various fans vary in size it is impossible to give definite figures; however, by following the above procedure accurate dimensions may be substituted. On old scrap tin or galvanized iron (old cans will do), lay out the front and back pieces using "A" diameter plus 2". Scribe another semicircle using a ⅜" larger radius. When cutting these pieces out follow this circumference. Then cut the "scallops" in the curved portion as shown in Fig. 1. Bend these back at 90 degrees by hammering, using a curved block of wood underneath. Cut another piece of sheet metal about 7½" wide of sufficient length to form the sides. Nail the front and back to a piece of ¾" thick wood whose dimensions are "A" diameter plus 2" and 7½". Nail the side strip to one side of the base and "tack" solder the side to the front and back pieces, bending to conform to the curvature as you progress. Then nail to the base

[*Continued on page 136*]

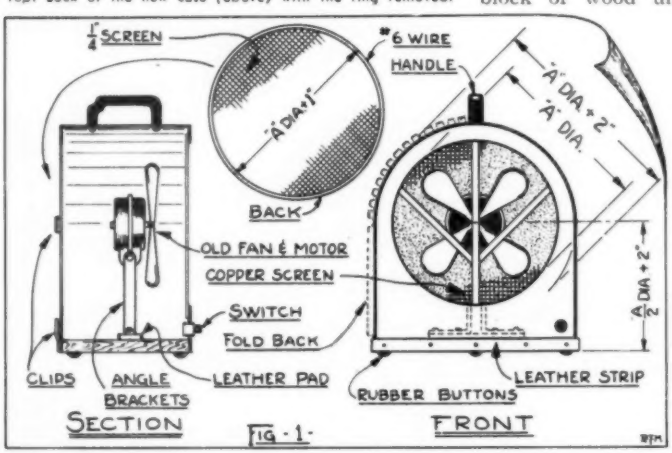


FIG. 1.

CELLARETTE and CRYSTAL CABINET

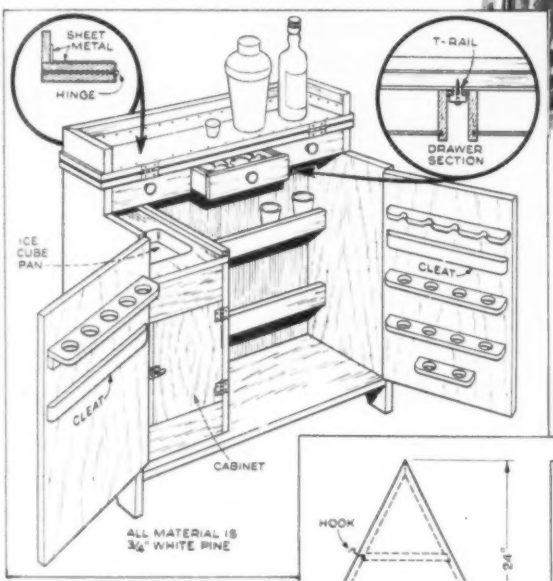
by Hi Sibley

THIS easily made cellarette-cabinet combination will add a decorative and festive touch to your entertainment room. Short lengths of pine make up most of the material.

If sheet metal is not available for the top, linoleum may be substituted. In this event, moulding should be applied around the edges.

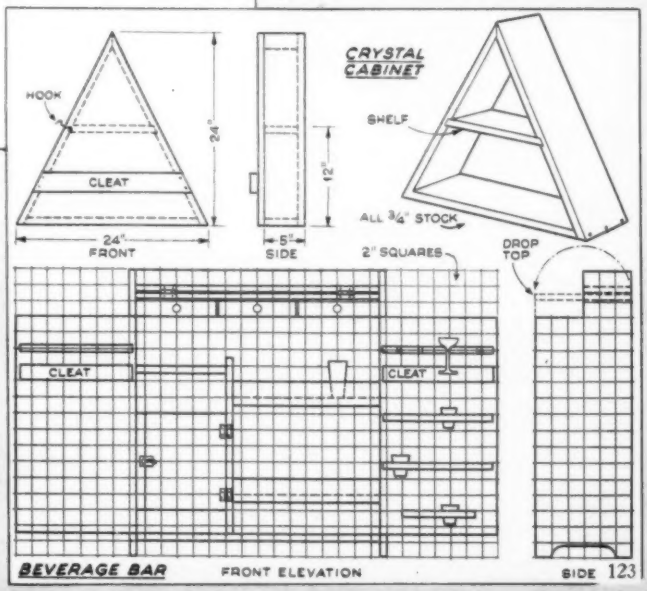
The crystal cabinet above the cellarette houses whatever glassware is not fitted into the holes in the cellarette shelves.

Completed bar-cellarette and wall cabinet will have this appearance if wood is scorched with blow torch, and rubbed with stiff wire brush.



Construction details and general layout of cellarette are shown above. Cut holes in door shelves to fit glasses. Top shelf on right may merely be notched to take wine glasses of the stem type.

Dimensions and location of all parts are shown at *right*. Cut lumber accurately, and fit before fastening. This is particularly important with drawers and doors.



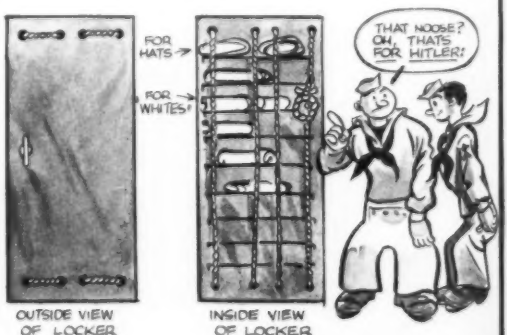
IDEAS FOR SERVICE MEN

Private V. W. Skorinko of Indiantown Gap, M. R., Pa., submits a nifty little idea this month. It's one that's going to get a lot of laughs out of civilians who don't know any better, but every service man will take it seriously because he'll know that Pvt. Skorinko isn't kidding. **"If you're in need of an ironing board,** use the mattress on your bunk," says he. With mattresses like that in the Army, we can see the reason for that song, "Sweet dreams, little soldier boy."

Methods of marking clothing usually aren't very satisfactory. An indelible pencil mark fades out after a couple of washings, and indelible ink is difficult to apply with an ordinary steel pen on soft cloth. You can mark the words of Cpl. Alvin C. Porter of Patterson Field, Fairfield, Ohio, and mark your clothes at the same time if you get an indelible ink pad and a stamp with your name and serial number on it from a stationery store and try those a few times on your dainty underthings. The letters will still remain long after the cloth itself has disappeared (we're told).

Heave to, me hearties, and hang on to this one from W. K. Johnson, U. S. Naval Hospital, Sampson, N. Y. He says if you're a sailor with a locker (quite different than one without a locker), you can make yourself a handy clothes rack by running ropes vertically through the ventilator holes on top and bottom of the locker door. Incidentally (and this isn't a cooking hint) leave your whites rolled and place them one on top of the other in the rack.

Mess kits, like tired feet after a long hike, are pretty hard to keep clean. A slip (of paper) between the cup and the canteen will prevent that



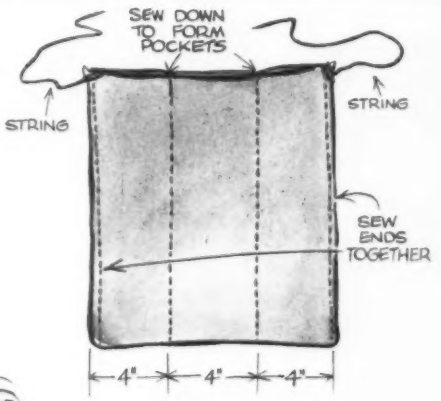
black stain which is caused by water in the canteen, and you'll be oh-so-happy. Private R. E. Daugherty of Camp Wolters, Texas, thinks so and he should know.

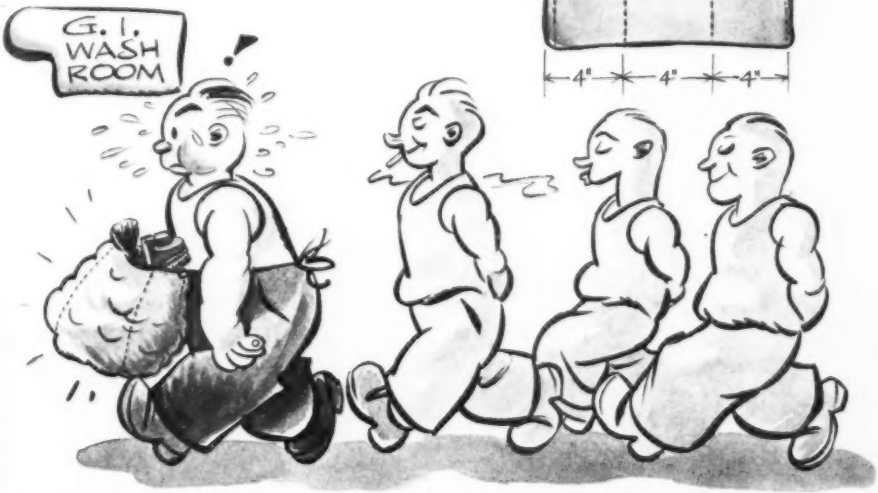
"Masking tape has a lot of uses for the Navy," states the communique of T. F. McConnon of the U. S. Naval Air Station, Quonset Point, R. I. It can be used to pick lint from your blues, hold up the gal-friend's picture in your locker, keep the crease in your hanky, and will even serve as a patch in a pinch should the old dungarees start tearing in embarassing places just before inspection. That's a time when you dassn't "let'r rip."

Bartenders and housewives aren't the only ones who find aprons quite necessary to the trade. Marine Private Carrol Jackson uses one, with pockets, to hold his shaving articles and other necessaries when he has to dash ahead of the other guys early in the a. m. He made it of an old towel and a GI sewing kit. He folded the long edges of the towel together and sewed pockets in it as shown in the sketch. The tying strings were sewn to the corners of finished apron.

SERVICE MEN, ATTENTION!

This is your department, and if you like it enough to want to make it better, you can. It's all up to you! Send in your ideas—anything you think may help your buddies in the Army, Navy or Marines. You'll be helping yourself, too, because MECHANIX ILLUSTRATED pays from $2.50 up for material used. Address "Ideas for Service Men," MECHANIX ILLUSTRATED, 1501 Broadway, New York, N. Y.

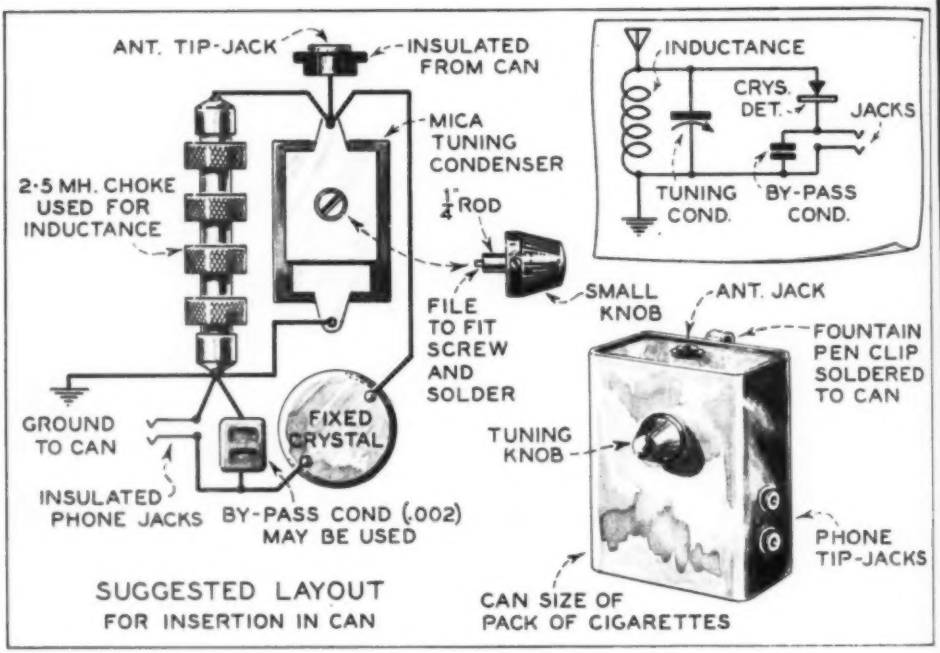




Vest Pocket Crystal Receiver

Here's a little crystal receiver which is no larger than a package of cigarettes.

by L. B. Robbins



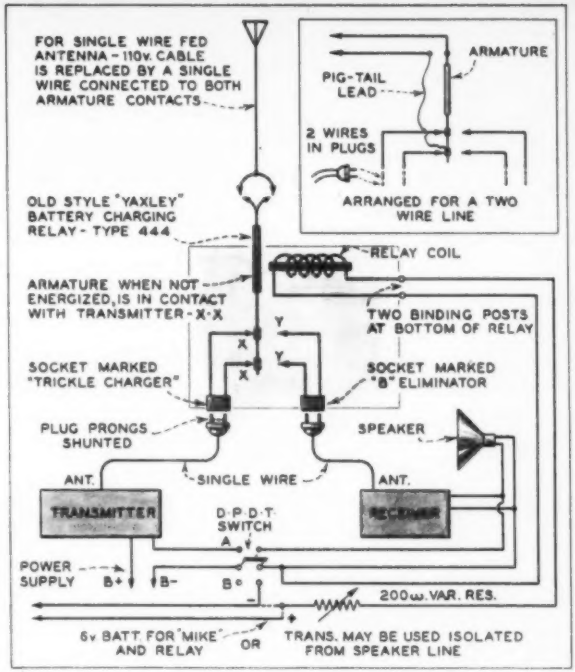
ADJUSTABLE in tuning and carried in the upper breast pocket, this tiny receiver is held securely in place by an ordinary fountain-pen clip. With but two or three feet of antenna wire and a pair of head-phones one can clearly receive broadcasts within a radius of two or three miles, or within city limits. The can used to house the original set was one constructed to hold just one pack of cigarettes. Some dime stores sell them or they may be procured at cigar stores.

The circuit used is the simplest known and is shown in the diagram. It consists of a tuning coil in series with a fixed crystal and midget phone tip-jacks; the circuit being shunted by a suitable tuning condenser of the compression type commonly known as a padding condenser. Compactness is obtained mainly by utilizing a 2.5 millihenry choke, used in short wave work, as the tuning coil. The four pies, tuned by a condenser of about 250 mmfd. maximum capacity, will cover most of the broadcast band quite well.

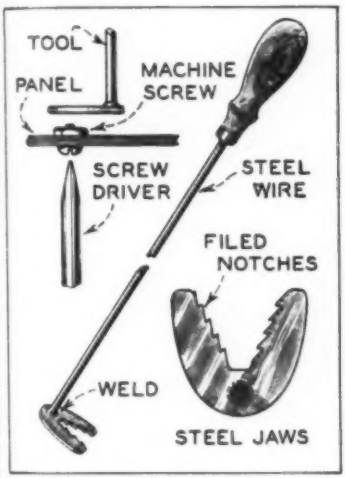
Lay out the parts on the bench in a compact form as shown in the drawing, arranging them according to their design so they will fit into the can with the condenser tuning shaft in a position to enter a suitable hole in the upper center of the can. Any parts that may come in contact with the can should be covered with bits of electricians' tape. Wire and connect the various elements together with buss wire, if possible, to gain solidity. Fit the two phone tip-jacks in the lower edge as shown, and arrange the insulated tip-jack for the antenna in the center of the bottom (used as the top). The open top (bottom) can be closed later if desired. Grounded portions can be caught to the can with a bit of solder when the assembly finally is made. When completely assembled in the can, a short piece of brass rod can be filed and fitted into [*Continued on page* 144]

Antenna Change-Over Relay From Charger

WITH the market now closed on many radio accessories, you will find it a simple matter to make an antenna change-over from an old Yaxley battery charging relay. Turn switch to A for sending; to B for receiving.



RADIO KINKS

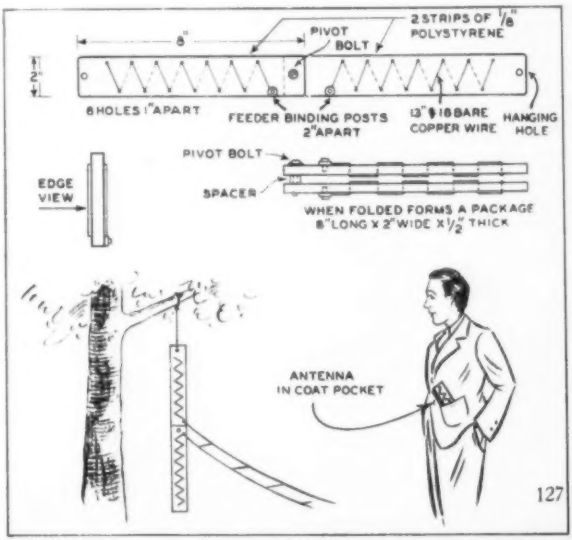


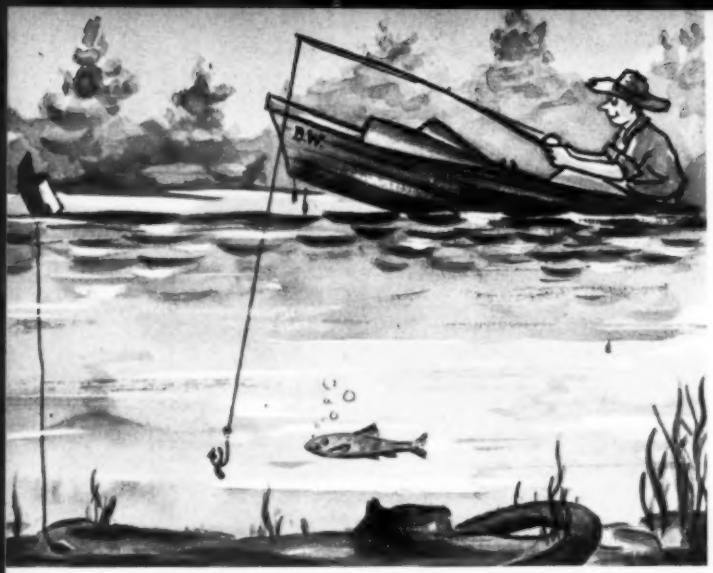
Pocket Size Antenna For UHF Work

THIS small, compact antenna will appeal to amateurs interested in ultra-high-frequency work for civilian defense. It takes up little room in a coat pocket and measures 8" overall when folded. Lap the two 8" lengths of polystyrene for a distance of 1" and drill a hole in the center of the lap. Put a ¼" spacer between the two pieces and pivot bolt them together. You will find this dipole antenna suitable for 2½, 1¼ and even ¾ meters.

Handy Tool For Locking Nuts

THE simple tool shown in the diagram at the left will help solve your assembly problems. It is made of hardened steel, and its shape is such that it will fit any nut of the sizes used in radio. To use, push the screw or bolt through the necessary holes to engage the nut and lower the jaws to grasp the nut, turning the screw head with a screwdriver from the opposite side. It will reach the really tight places.



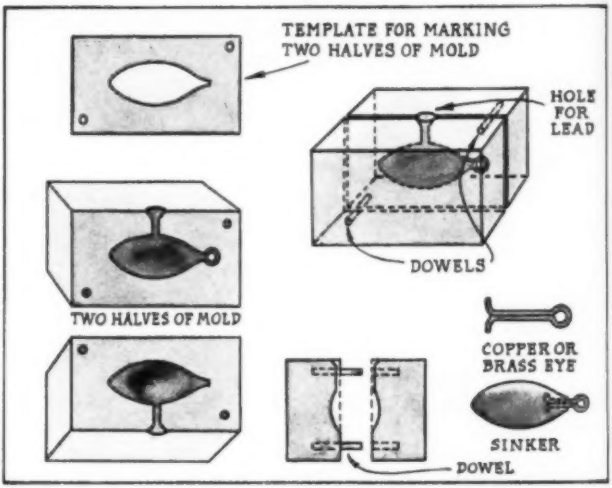


Tin Can Buoys For Fishing

EVERY lake has its good fishing spots. Here's a method you can use to mark that ol' bass or pike hole so you'll be able to find it again the next time you troll by. Carry along some empty cans to which you have tied lengths of string and sinkers. When you hit a good place, toss out the can, and the string and sinker will hold it like an anchored buoy to mark the spot for you.

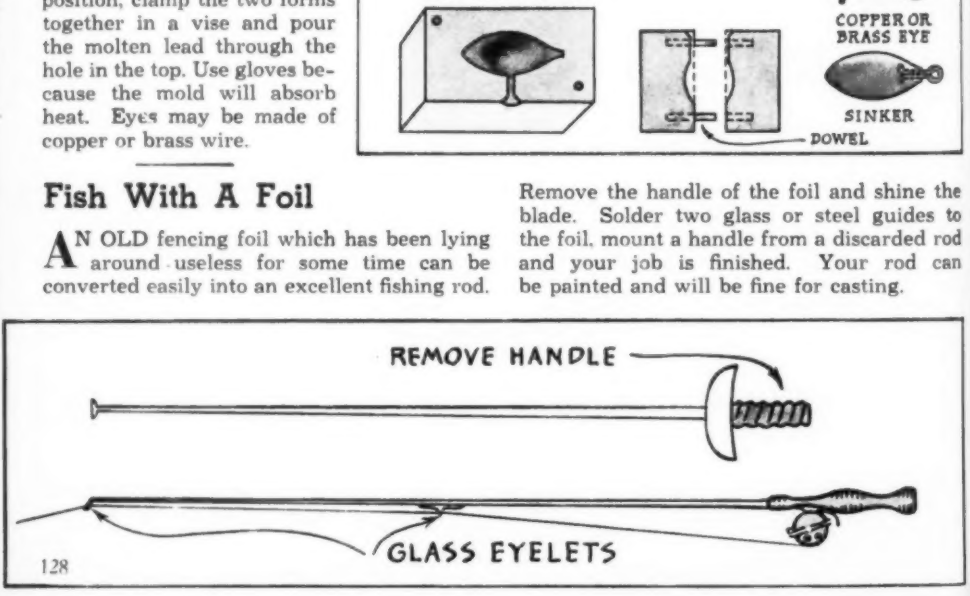
Mold For Sinkers From Carbon Brush

THE fisherman can easily make his own supply of lead sinkers by using this mold made from large, carbon brushes of the type used in generators. Cut the blocks as indicated; only one piece has to be hollowed for the eye. To use, simply place the eye in position, clamp the two forms together in a vise and pour the molten lead through the hole in the top. Use gloves because the mold will absorb heat. Eyes may be made of copper or brass wire.



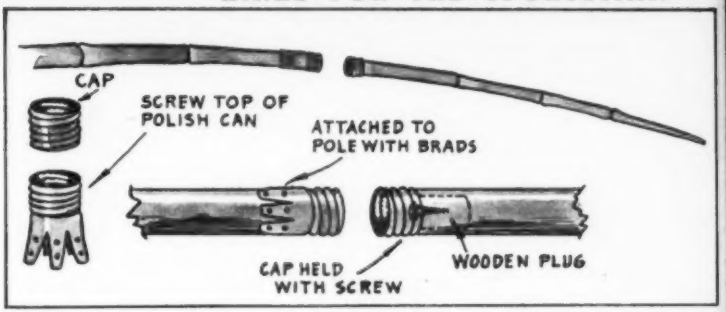
Fish With A Foil

AN OLD fencing foil which has been lying around useless for some time can be converted easily into an excellent fishing rod. Remove the handle of the foil and shine the blade. Solder two glass or steel guides to the foil, mount a handle from a discarded rod and your job is finished. Your rod can be painted and will be fine for casting.



Joints For Bamboo Poles

CANE and bamboo fishing poles are usually very tricky outfits to handle because of their extreme length. Joints can be made for them very easily from tops and caps of old polish cans.

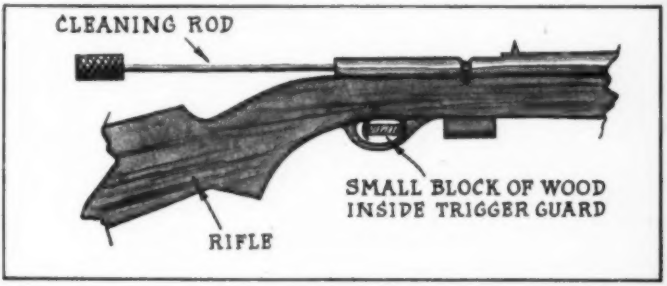


Clock For Timing Revolver Practice

A SIMPLE way to develop accuracy in timed and rapid-fire revolver shooting is to practice "dry" shooting with the sweep-second hand of an electric clock furnishing both the target and the timing means. A few evenings of snap-shooting of this kind will lead to far better scores on week-end shoots.

Trigger Lock Aids Rifle Cleaning

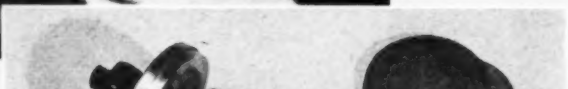
AFTER removing the bolt of a rifle to clean the bore, you will find that the sear (little finger which releases the hammer) will block the passage of the cleaning rod. Wooden block inside guard is the remedy.

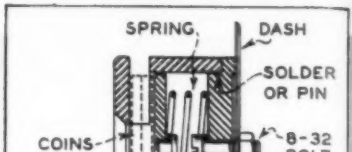


Name Labels For Picnic Sandwiches

THIS little trick will startle you with its simplicity. It will remedy a picnic problem which is quite common to all of us. Label each sandwich with a small sticker bearing its name and you won't have to unwrap each sandwich to find the type desired.

Auto Suggestions



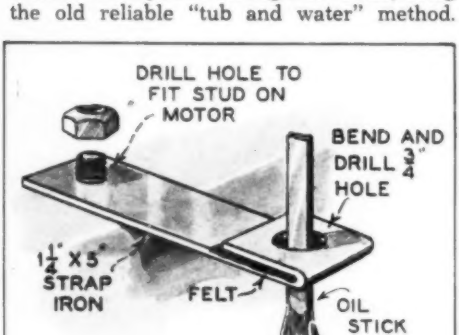


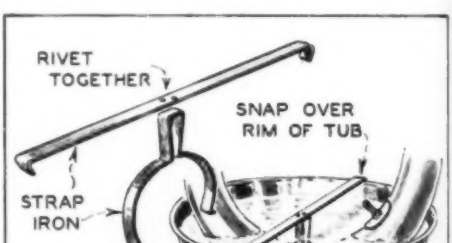
Dashboard Holder For Coins

IF YOU'VE ever pulled up to a parking meter or the station on a toll bridge and found all too late that you didn't have the necessary change, you'll appreciate this little dashboard gadget. It will hold a number of coins for you—nickels, dimes or pennies. Machine it from scrap metal and fasten it to the dash with a bolt.

Clamp Holds Inner Tube

A CLAMP, made as illustrated at the right, will keep an inner tube from getting out of hand when you're testing it for leaks, using the old reliable "tub and water" method.





Engine Oil Gauge Wiper

CLAMP this wiper to a pan bolt of your engine and you won't have to waste time searching for a cloth every time you want to check your motor oil. To use, just draw the gauge rod through the felt slit.

Conserve Your Refrigerator

[*Continued from page* 114]

refrigerant before allowing it to expand in the cooling unit. The old-fashioned outfits had large circular coils out on the top of the box; the newer ones have the cooling coil located beneath where air is circulated by means of a motor-driven fan.

In many cases, however, it is difficult for the fan to draw a sufficient quantity of air to cool the coil efficiently because the front of the refrigerator is completely enclosed and the box itself is set in an alcove or corner which makes good circulation impossible. To remedy this simply remove the lower front cover of the assembly unit and make a screen to take its place as shown in the diagram and photo. Make a channel frame of heavy gauge sheet metal with the channel wide enough to fit over the lip of the opening. One side and end should have a narrow inside flange to permit inserting the frame in place. Notch the channel, bend the frame to the desired size and reinforce with braces and angle plates. The angle plates should be made of the same material as the frame.

Spot-solder on the back first a screen of ¼" mesh and then a screen of 1/16" mesh. The fine screen shuts off the view of the power unit and the heavy screen protects the front against any accidental bumping which may occur. A metal cutout design can be spot-soldered to the front of the screen and painted or enameled to match the color of the refrigerator if desired.

Here are a few more hints for conservation:

Ice is a good insulator. If you don't defrost your machine when it collects in quantity on the cooling unit, the unit will not be able to absorb heat properly and the efficiency of the refrigerator will be reduced. To defrost, turn the switch to "Defrost"; don't shut off the machine entirely.

Don't tug and hammer at the ice trays when they have become frozen in the unit—and don't poke at them with an icepick. If you punch a hole in the system you'll find that the gas used as a refrigerant is neither pleasant nor healthy. Slide a knife under the tray and dislodge gently. Pouring hot water on the trays to loosen them doesn't do your refrigerator any good, either.

Treat your aluminum and rubber trays as if they were made of gold. In fact they are as scarce as gold at the present time.

Don't put hot or steaming foods in your refrigerator. The poor machine will wear itself out trying to cool them for you. When it has a heart attack, it costs you money.

Finally, if you have a friend who insists that hot water will freeze more quickly in the trays than cold water, do the chap a favor and put him in contact with a good psychiatrist.

Antique English Dumbwaiter

[*Continued from page* 117]

bottom section for mortising the legs. These cuts are easily and accurately made by tacking a wood cleat on the bottom end of the standard as in the photo. This cleat prevents turning of the work while cutting. The second strip, which acts as a stop, is simply clamped on the saw table. The cleat must be removed and tacked in position for each cut. Tenons on the legs are fitted into the mortised cuts temporarily without glue while holes for the locking dowels are bored. Mark each leg as it is fitted so it may be returned to the proper groove when assembled.

In assembling, the legs and locking dowels are glued into the previously fitted grooves. When dry, glue is applied to the stepped tenon and the large tier is slipped on. Then the top half of the standard is slipped over the protruding tenon of the bottom section of the standard. The free-turning brace is now slipped on and assembly is completed by gluing the top tier to the tenon. Care should be taken to keep glue from the stepped tenon as the brace must be free to turn so leaves may be raised or lowered.

The turned standard parts are finished with shellac while in the lathe. After assembling, the tiers and legs are given three coats of shellac, rubbing down well between coats.

Brown rice is eight times as rich in iron, thiamin, and riboflavin as polished rice.

Rock Gardens

[*Continued from page* 99]

or side of the building. In climates where cactus plants must be taken into the house in winter, they may be set in the sand without removing their pots. In the dryer and warmer South and Southwest they may be planted directly into the sand. This sand should be desert sand, however, which has some nourishment. Beach sand is barren.

A similar arrangement of stones, as in Fig. 2, will preserve a steep terrace at the edge of the lawn and will discourage children from running up and down the banks. Stones also tend to hold the moisture in your garden and will aid the growth of stronger, healthier plants.

Gouges For Model Boats

[*Continued from page* 107]

maple. Blades are held in place with two round-head screws and washers, and they may be adjusted quickly for any depth of cut. They may be bent to fit the various curves of the inside of the boat's hull. You'll be amazed at the fast and smooth job you can turn out with them.

Animals are generally immune to poison ivy; some species eat it freely.

Working Rough Timber

[*Continued from page 93*]

and trunk-shoots and then cut the trunk to the length or lengths of the beams you require. Then, unless you have adequate hauling facilities and prefer to work on the logs at home, it is best to trim them right on the spot.

To trim a long square takes more care and patience than it does skill. Begin by laying the log on two supports to raise it several inches off the ground. Drive a nail at each end as shown at B in Fig. 2 and stretch a line tightly between them. Then cut one side of the log to a true flat surface by following the line as a guide. Use a broadax as shown in the photograph and begin at the small end and work toward the butt. Sight frequently along the cut in order to keep it running absolutely straight. In this way you can correct any tendency it may have to take a twist.

Next, scratch a guide line down the opposite side of the log with the aid of a simple gauge made from a piece of board and a nail as shown in Fig. 2C. The span of the gauge should, of course, correspond to the thickness of the finished beam. Now trim along this line, again taking care to sight frequently along the cut. Also slip the gauge under the log now and then to check the work for thickness along the lower edge.

To cut the third side, stretch the line as before and trim along it. This time make regular checks for squareness as well as straightness, using a square for the purpose as shown in Fig. 2D. Occasionally gauge the thickness.

Finally scribe a line for the fourth and last cut and finish the trimming, checking with both square and gauge as you proceed.

Hand-hewn beams that have been carefully trimmed to shape and size with a sharp broadax require no further finishing for most construction purposes. However, if a planed surface is desired, set the chip-clearance on the plane cutter quite wide (about ⅛") and rough off the high spots. This will prevent clogging up the cutter. Then readjust the clearance and make the finish cuts.

If you find it necessary to produce a full-length beam from a crooked tree, you may find it expedient to cut the log in two lengths, trim each separately and then join them later, rather than attempt to do a one-piece job. An all-purpose timber splice for this job is illustrated at A in Fig. 3, along with the pattern of a template for laying out the matching halves of the joint. This splice is designed for building uses that require it to take tension, compression, and cross strain. Of course, all three qualities are not always demanded of a joint and this one can be simplified accordingly. For example, if no cross strain will be put on it, the small vertical tongues X can be eliminated, while the simplified version shown at 3B can be used if neither cross strain nor compression will be encountered. If the beam is to be used as a sill and laid on a continuous solid foundation where practically no stress will be put on it, simply notch the crooked log as shown at 3C, drive in a wedge to straighten it and then trim the log as described previously. This trick will save you both time and material.

The template shown in the photographs and drawing in Figs. 4 and 5 will be found handy for laying out cuts on ax-hewn and other rough timber. It is a combination square and mortise-and-tenon gauge made for use on 6" beams. Its dimensions can be altered, however, to fit beams of a different size. Rough timber can be marked more accurately with it than with an ordinary steel square because it offers a large and flat surface to the beam instead of a knife-like edge. Thus it spans irregularities that cause a steel square to register inaccurately.

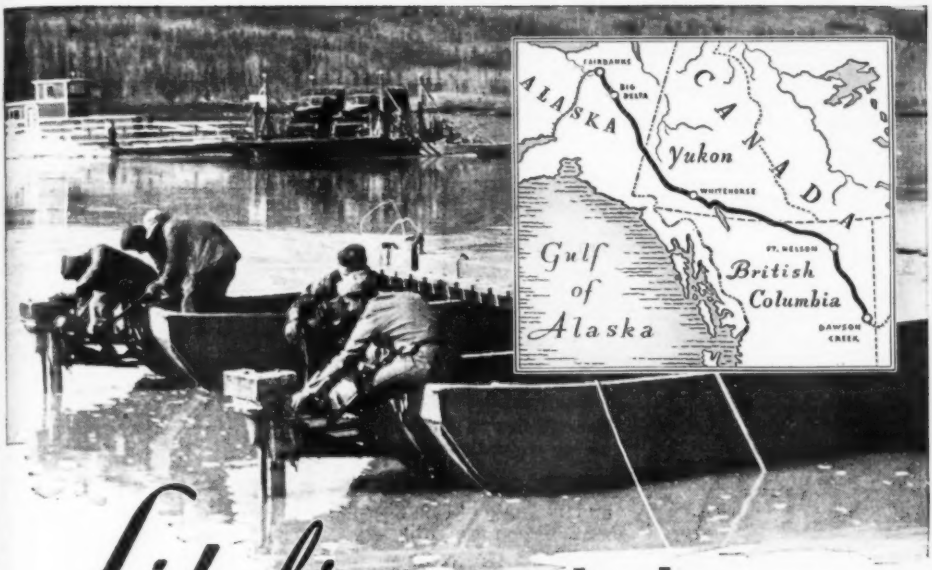
Logs can be ripped down the center by hand although the task is a tedious one. In most cases it is more practical to trim one face with a broadax and then take the log to a lumber yard to be ripped on a power saw. Mill-ripping wastes quite a bit of material, however, due to the wide cut of the saw. Therefore, if the size of the log does not allow for more waste than the cut of a hand saw, the job will have to be done by hand. In this event, lay the log over two saw horses and snap a chalk line down the center as shown in Fig. 6. Now drop a short plumb line from each end of the chalk line, thus accurately bisecting the log. Then snap a second chalk line on the opposite side of the log, using the bisectors as marks. This will give you a saw line on both sides of the log. Start to saw from the small end and rip 3" or 4". Then turn the log over and do the same on the other side. Repeat this procedure until the cut is finished.

The pair of 16' ladder stringers shown in the photograph were cut from a columnar-shaped cedar tree which barely topped their length in height. The log was ripped down the center with a hand saw in the manner described and the halves were then mill-dressed down to uniform thickness. The ladder was made according to the plan for building a 12' ladder that appeared in the March, 1942 issue of MECHANIX ILLUSTRATED. The dimensions, of course, were altered to suit a 16' length. The finished cedar ladder turned out to be an exceptionally light-weight job for its size and strength. One man can handle it easily, which fact is not true of the average ladder of this size. It was therefore well worth while to expend the time and effort finding the *right* timber.

The element, xenon, makes up only 0.000009% of the volume of the atmosphere.

There are clams on the Great Barrier Reef that weigh several hundred pounds.

Treated with zinc chloride by a new method evolved by government scientists, fence posts last 10 to 15 years longer than untreated posts.



Lifeline to Alaska

1600 miles across rivers and through forests . . . over mountains and muskeg . . . in 9 months U. S. Engineers create the Alcan Highway . . . and Evinrudes were on the job!

"Impossible . . . fantastic . . . monstrous," said the critics. Towering mountain ranges, vast wilderness, great rivers, every obstacle known to road builders blocked the way. A fraction of the project could easily take years to complete.

In March the Corps of Engineers swung into action. Miracles were demanded — and accomplished. The world knows only the results. In December the Alcan Highway was through! The lifeline for Alaska's defense and America's safety stretched securely from Dawson to Fairbanks, and trains of freighter trucks were rolling the length of it!

Alcan is a military highway now . . . but some peaceful summer to come you may decide to try your fishing luck in sporty lakes and rivers up near the Arctic Circle! Swiftly covering these spectacular miles you'll gain fresh appreciation of the greatest road building accomplishment in history!

We're proud that Evinrudes served on *that* job . . . and equally proud of the Evinrudes that are faithfully performing many another wartime task for the army, navy and marines. Until Victory, Evinrudes are being built only for the armed services . . . then there will be brilliant new Evinrudes for peacetime pleasures again!

EVINRUDE MOTORS, *Milwaukee, Wis.*

Evinrude Motors of Canada, Peterboro, Canada

★ *To speed the day of peace . . . buy MORE War Bonds.*

EVINRUDE
OUTBOARD MOTORS

Your Wartime Car

by Frederick C. Russell

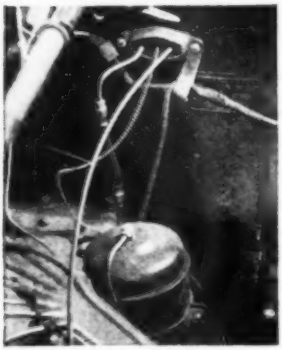
If you have a problem with your car, ask Mr. Russell. Just send stamped, self-addressed envelope for a personal reply.

Is there any real harm in letting the battery stand when it is discharged? K. W. McA.

Yes. Recharging it may become impossible.

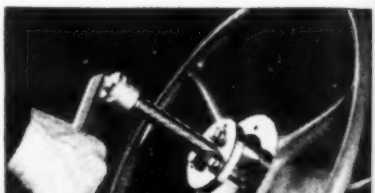
Try it!

If the fuel pump has gone dry you can save the battery while cranking by removing the spark plugs. This accelerates cranking speed, primes the pump faster, and fills the carburetor bowl so that the engine will have fuel on which to feed. Disconnect the high tension wire at the distributor to prevent the ignition system from operating during this process. The engine is then being cranked as if by hand with ignition off.



You said that if the oil filter feels hot the oil is still circulating through it, and its cartridge probably isn't clogged. The filter on my car was hot even though it had stopped filtering. K. H. E.

That is because the particular filter is mounted on the engine and is heated through contact. Install a filter that can be mounted on the dash.



How can I remove the steering wheel? T. M. D.

You'll need a steering wheel puller for this. Cap screws fit into special tapped holes in the wheel hub.

After checking over valve clearances I have been getting a lot of pinging. How come? S. S. T.

You did not provide enough clearance.

I have a headlight adjusting chart in my garage. How far should the car be from the chart when testing focus? M. A. A.

Twenty-five feet. Test with normal load in the car since rear-end sag will throw the light rays up to where they would normally be as you drive.

Gears have never shifted easily in my car. Have checked the gear lube and all connections along the remote shift layout. Alignment is good. B. K. G.

Take out the steering post control tube and examine the shifter shaft. It may be slightly bent.

During warm-up I never can tell whether the engine is over-choked or is on a too lean mixture. E. B. W.

If the mixture is lean the engine will go dead, stall or backfire through the carburetor when you step on the gas. If it is too rich it will gallop, buck or jerk.

MOTORISTS *Wanted!*

TO MAKE THIS *UNIQUE TEST...*

of GAS SAVINGS

Car Owners: You are invited to make a gas saving road test with the Vacu-matic on your own car, with the absolute understanding that unless it proves to you that it will save you up to 30% on gas and improve your car performance, the test will cost you nothing. Investigate this remarkable discovery that trims dollars off gasoline bills—gives you worthwhile gas savings—more power—quicker starting—more miles on less gas.

Automatic Supercharge Principle

Vacu-matic is *entirely different!* It operates on the supercharge principle by automatically adding a charge of extra oxygen, drawn free from the outer air, into the heart of the gas mixture. It is entirely automatic and allows the motor to "breathe" at the correct time, opening and closing *automatically* to save dollars on gas costs.

Proven By Test

In addition to establishing new mileage records on cars in all sections of the country, the Vacu-matic has proven itself on thousands of road tests and on dynamometer tests which duplicate road conditions and record accurate mileage and horsepower increases.

Fits All Cars—Easy to Install

Vacu-matic is constructed of six parts assembled and fused into one unit, adjusted and *sealed at the factory.* Nothing to regulate. Any motorist can install in ten minutes. The free offer coupon will bring all the facts. Mail it today!

The Vacu-matic Co., Wauwatosa, Wis.

Sworn Proof of Gas Savings

This certifies that I have carefully read 300 original letters received from Vacu-matic users testifying to gas savings up to 30%, many reporting added power, smoother running, and quicker pick-up. These letters are just a small part of the larger file of enthusiastic user letters that I saw at the company offices.

Signed

Notary Public

AGENTS Get Yours FREE For Introducing

Vacu-matic offers a splendid opportunity for unusual sales and profits. Every car, truck, tractor, and motorcycle owner a prospect. Valuable territories now being assigned. If you help us introduce it to a friend, you can obtain your own free. Check and mail coupon today.

SEND THIS *Free Offer* COUPON

THE VACU-MATIC COMPANY
7617-819 W. State St., Wauwatosa, Wis.
Please send full particulars about VACU-MATIC, also how I may obtain one for my own car FREE. This does not obligate me in any way.

Name .....

Address .....

City..... State.....

☐ Check here if interested in Agency Proposition.

Photo-Print Lamp Shades

[*Continued from page 84*]

having a sensitive emulsion on both sides of a translucent stock. When properly exposed and developed, the image on one side is slightly glossy and on the other side, matte. Expose with the glossy side up, disregarding the matte surface as the picture will print through the paper stock, producing both images with the single exposure. It's a good idea to keep a sheet of black paper on the enlarging easel or paper holder, to absorb reflections which debase the image gradation.

The developing process is exactly the same as in the making of any enlargement. Any regular paper developer such as D-72 or D-52 may be used for Translite. Develop to a medium density, rinse in an acetic acid shortstop, and fix in a fresh hypo bath. Wash in the usual manner. (Translite paper blisters easily so give special attention to the temperatures of the solutions and wash water —do not warm them.)

Finally, dry the prints in a blotter roll or lay them face up on clean white sheets.

Royal redeveloper solution will give a rich chocolate sepia tone to the black and white prints. This tone in itself will take the place of color. Coloring the prints, however, will greatly enhance the beauty of the shade, and besides you will find the sepia-toned prints easier to color than the plain black and white.

Coloring should be done with transparent oil colors as they have an inherent body character which tends to build up deficiencies in the tone depth. The tints should be well blended and a little stronger than when used on a regular print.

Color the matte or reverse side first. Do not go into detail about small objects on this side as the color is used to give depth only. Hang up and allow to dry thoroughly before coloring the front side. Place the color on this side to match exactly with the color on the matte side of the picture so that when the shade is illuminated, there will be no overlapping of colors. When the coloring is completed, hang the prints on a line, using clip clothespins as weights so that they will dry straight, and allow at least 24 hours for the paint to dry.

Apply the shellac evenly but thinly with a clean brush to the matte side of the print first, again hanging it up to dry. After complete drying, apply the shellac to the front side and hang it up again.

In making the patterns for the panels, lay the wire frame on a sheet of plain white paper and draw a line around the outside of the wire panel. Trim on the lines and fit this pattern to the panel of the frame. If too large, trim the edges to fit so they will not overlap. Punch the eyelets at equal distances, about an inch apart, around the pattern and about one-quarter inch from the edges as illustrated on page 84.

Fit the pictures to the pattern, and trim and punch eyelets on each print separately. After all the prints have been properly trimmed and punched, hold them in place on the wire frame with clip clothespins and lace each panel separately as illustrated. Finish the loose ends by tucking under the finished lacings.

The finished lamp shade with its lamp may be displayed anywhere in the house—on a radio, bookcase, table or shelf. It will please both you and your family because it will be an intimate record for your home. Incidentally, your picture story will be apparent whether the lamp is lighted or not.

Fix Up That Old Fan!

[*Continued from page 122*]

as before. Now solder the seams completely using acid and a hot iron, filling in any depressions as you go.

After soldering file off all rough edges. Solder three pieces of light metal over the front opening as shown and then solder a piece of copper screening over this opening. Drill the top to receive a suitable handle. The one shown is from an old coffee maker. Now locate the fan in place and screw the brackets to the base, using a piece of leather or felt between the bracket and the wood. This will deaden the vibration sound. A small light switch is then located at the front and a hard rubber grommet at the back. This is a bushing through which the cord enters the case. It may be taken from the back of an old light socket. Wire the motor to the switch and power supply by connecting one wire from the motor to the switch and the other two wires to the power. A ring of No. 6 wire is now bent and covered with ¼" screening, then soldered to the ring. Trim evenly and file to remove sharp edges. Bend three clips as shown in Fig. 1 and solder them to the back. They will serve to hold the back screen ring in place.

Wipe the entire surface with vinegar if galvanized metal was used. Enamel the fan to suit its surroundings.

You will note that this fan is easy to move from one place to another and that it may be used around small children without danger in as much as the fan is completely guarded.

A Florida industrial plant is producing grapefruit seed oil, found useful in textile dyeing.

Frozen meat may be cooked in frozen condition, although thawed meat cooks more rapidly, experiment station scientists say.

_turn their binoculars this way!

IN a wave-tossed rubber raft, survivors from a lost plane count ahead: How many more days will food and water last? Count back: How many days have they drifted—*away* from possible rescue? Count their chances to live!

Then—so far off, it can hardly be identified as one of our own—a single plane.

Saved? Not yet!... *Only with binoculars could the men in the plane possibly see them.*

Those on the raft, fliers themselves, know that. Fear that those up there who are using binoculars are too intent on sighting their objective to spot that tiny raft.

If so, their frantic waving is as futile as their shouts, and only prayers can help: "Please, Lord! Turn their binoculars *this* way!"

Every minute, *every* day and night, our men use binoculars to save lives, uncover ambushes, warn of submarines, sight enemy aircraft.

Wherever *your* boy is, binoculars are keeping watch—helping him and his comrades to destroy our enemies, and hasten Victory.

THESE FIGHT TOO!... Universal is one of the few manufacturers making binoculars for the Army, Navy and Marines, and the United Nations. It has pioneered in ingenious new methods of production and assembly of lenses, prisms and precision optical instruments—many of them significant contributions to America's future leadership in this highly specialized field.

REMEMBER YOUR PLEDGE TO BUY WAR BONDS, AND LIVE UP TO IT!

There's only one flag we're prouder of!

UNIVERSAL CAMERA CORPORATION

NEW YORK • CHICAGO • HOLLYWOOD

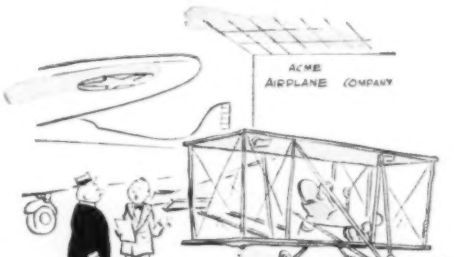
Makers of Precision Photographic and Optical Instruments • Peacetime Manufacturers of Cinémaster, Mercury, Corsair Cameras

[*Continued from page* 103]

prominent objects can be readily seen and identified. *Contact flight* is flight which can be controlled at all times by visual reference to the land or water.

Besides observing the minimum altitude regulations during our flight, we must also observe minimum ceilings and visibilities. For contact flight, we must keep 500 ft. below the overcast or cloud formation. Our minimum ceiling, therefore, will be our minimum altitude plus 500 ft.

The rules for minimum visibilities appear mighty complicated in your textbook, but they can be stated very simply. The general rule is that you must have a three-mile visibility for contact flight. There are two exceptions to this rule. They are: outside of a control zone below 1,000 ft., and inside a control zone below 1,000 ft., with the approval of the control tower operator. Under these exceptions, your visibility must be one mile during the day and two miles at night. On our flight if we should encounter ceilings or visibilities which do not meet the minimum requirements, we must choose a different course, fly back home, or land and wait for the weather to change.



"Now here's one that you can have rather cheap!"

Let's say we decide to perform a few acrobatic maneuvers. We can go right ahead as long as we aren't inside a control zone, over a congested area, or over or within 1,000 ft. of any airport. Only an inspector giving a flight test can fly acrobatically within a control zone. A pilot can take a passenger with him, too, but not for hire. Only a licensed flight instructor can fly acrobatically for hire. Our ceiling must be at least 3,000 ft., our visibility three miles and our maneuver must be completed no lower than 1,500 ft. Acrobatics started too close to the ground frequently end six feet under the ground. Pilot and passengers in acrobatic flight must each wear a parachute which has been repacked within the preceding sixty days by a licensed mechanic with a parachute rigger's rating.

If, during our jaunt, we should decide to fly above the clouds or "over-the-top" in contact flight, we must not come closer horizontally than 2,000 ft. to any cloud formation, and once above the cloud level, we must be able to control our flight by visual reference to the ground or water.

Having completed our trip, we'll return to the airport. With a tower on the field, we must await instructions before landing. As we approach the airport, we circle it to the left (the traffic pattern) unless advised to the contrary. All traffic within a radius of three miles of the field must obey this rule. We cannot fly directly over the field at an altitude of less than 1,500 ft. When approaching to land, the plane at the lowest altitude has the right-of-way. Transient traffic (airliners, etc.) always have the right-of-way in landing for safety's sake. In landing, our plane must maintain a straight glide of at least 1,000 ft. before crossing the airport boundary.

For a flight at night, our plane must be equipped with position lights—a red light on the port or left wing tip, a green light on the starboard or right wing tip and a white light on the tail. Landing lights are necessary if our plane is to be operated for hire. An airship has the same lighting arrangement except that the side lights are doubled horizontally and the tail light is doubled vertically. A free balloon carries a steady white light and a flashing red light.

In case of trouble while flying, the distress signal *SOS* is used in radio, *MADAY* in a radio-telephony and *PAN* to indicate a forced landing. Violations of air traffic rules are allowed in cases of emergency, but a written report must be made to the Administrator of Civil Aeronautics within twenty-four hours of the violation. Penalties for violations range from $500 for a traffic rule to $1,000 for acrobatic flight over a congested area and $5,000 and five years for a light or signal offense.

Now let's take a look at the pilot, himself. Every pilot must possess an airman's certificate or license, an airman rating record which is attached to the certificate and states the special ratings, limitations and type of aircraft which may be flown by him, an identification card issued by the C.A.A. and a medical certificate which he obtains once a year from a C.A.A. medical examiner. To qualify for these he must be a citizen of the United States or of a friendly country.

There are four grades of pilot certificates: The Student, Private, Commercial and Airline Transport, and also two special ratings; Flight Instructor and Instrument. The minimum age for a Student Pilot is 16. Anyone may take dual instruction with an instructor without a student's "ticket," however. The Student license is issued

[*Continued on page* 140]

KNOWLEDGE
THAT HAS
ENDURED WITH THE
PYRAMIDS

A SECRET METHOD FOR THE MASTERY OF LIFE

WHENCE came the knowledge that built the Pyramids and the mighty Temples of the Pharaohs? Civilization began in the Nile Valley centuries ago. Where did its first builders acquire their astounding wisdom that started man on his upward climb? Beginning with naught they overcame nature's forces and gave the world its first sciences and arts. Did their knowledge come from a race now submerged beneath the sea, or were they touched with Infinite inspiration? From what concealed source came the wisdom that produced such characters as Amenhotep IV, Leonardo da Vinci, Isaac Newton, and a host of others?

Today it is known that they discovered and learned to interpret certain *Secret Methods* for the development of their inner power of mind. They learned to command the inner forces within their own beings, and to master life. This secret art of living has been preserved and handed down throughout the ages. Today it is extended to those who dare to use its profound principles to meet and solve the problems of life in these complex times.

AMENHOTEP IV
Founder of Egypt's
Mystery Schools

This Sealed Book—FREE

Has life brought you that personal satisfaction, the sense of achievement and happiness that you desire? If not, it is your duty to yourself to learn about this rational method of applying natural laws for the mastery of life. To the thoughtful person it is obvious that everyone cannot be entrusted with an intimate knowledge of the mysteries of life, for everyone is not capable of properly using it. But if you are one of those possessed of a true desire to forge ahead and wish to make use of the subtle influences of life, the Rosicrucians (not a religious organization) will send you A Sealed Book of explanation without obligation. This Sealed Book tells how you, in the privacy of your own home, without interference with your personal affairs or manner of living, may receive these secret teachings. Not weird or strange practices, but a rational application of the basic laws of life. Use the coupon, and obtain your complimentary copy.

Use this coupon for **FREE** *copy of book*

SCRIBE X. D. G.
The Rosicrucians (AMORC)
San Jose, California

Please send free copy of Sealed Book, which I shall read as directed.

NAME_____

ADDRESS_____

CITY_____

The ROSICRUCIANS
SAN JOSE (AMORC) CALIFORNIA

[*Continued from page* 138]

by the medical examiner upon completion of the physical exam which is not very severe. Your eyes and heart are the important items. Glasses won't keep you from flying. When you have completed at least eight hours dual instruction, you must pass a written exam in air traffic rules given you by your instructor, he signs the back of your license and you may "solo." You must keep a pilot's log book and your instructor signs for your dual time. After you have soloed, you must fly at least thirty-five hours by yourself. A student license does *not* permit you to carry passengers. This solo time is certified to by yourself. When it has been completed, you must pass a C.A.A. written exam in Civil Air Regulations, Navigation, Meteorology and General Service of Aircraft, and also a flight test after which you are issued your Private certificate. The minimum age for a Private or Commercial Pilot is 18. If you are under 21, you must furnish the written consent of your parent or guardian before you can start your flying.

As a Private Pilot you may carry passengers not for hire and count in your log book as solo time all the flying you do as sole manipulator of the controls of the plane. When your total has reached 200 hours, you may take written and flight tests for your Commercial license, Instructor's rating or Instrument rating or all three. Only a Commercial Pilot may be paid for his flying. In order to keep a student's certificate valid, the owner must take a medical exam every year. The same is true for a Private and Commercial Pilot. In order to fly solo, a Private or Commercial Pilot must be able to show in his log book that he has made at least five take-offs and landings within the preceding six months. If he cannot show these, he must take a check flight with an instructor or a pilot who has more than 200 hours. To carry passengers he must be able to show at least five take-offs and landings within the preceding ninety days. If he cannot, he must perform them before taking up his passengers.

Every plane which takes to the air must carry two certificates; a Registration and an Airworthiness Certificate. The first proves that the owner is a citizen and the second that the plane is safe to fly. The Registration Certificate becomes invalid; at the request of the plane owner, if the plane is registered in another country, if the plane is scrapped or when the plane is sold. When buying a plane, the new owner must file an application for a new Registration Certificate on the same day as the sale. The Airworthiness Certificate stays with the ship. Every plane must possess an Aircraft Log and a log for each engine. To maintain the Airworthiness Certificate valid, the plane must be inspected every 100 hours by a licensed mechanic who enters the date of the inspection in the log books. With the Airworthiness Certificate is an Aircraft Operation Record which is not a log book but a statement of the operating limits and performance of that aircraft.

The registration numbers and letter symbols are painted on the wings and tail of the plane. The letters *NC* precede the numbers on most ships. The *N* is the symbol for a plane registered in the United States. The *C* indicates that the plane is fully airworthy and safe to fly. Should you see a plane with *NR* preceding the numbers, you will know that the *R* means that the plane is airworthy for certain purposes only, crop-dusting for example. The *X* in *NX* indicates an experimental ship. When a new plane is purchased from the manufacturer, a Type and Production Certificate are supplied which may be exchanged at the C.A.A. office for an Airworthiness Certificate.

In case of an accident resulting in personal injury or one due directly to structural failure of the plane, the ship must not be moved until the accident is investigated by representatives of the C.A.A. Exceptions to this rule may be taken; when it is necessary to move the plane to free someone trapped in the wreckage, when the plane is obstructing highway traffic or when moving will preserve it from further serious damage. By keeping a close check on all such accidents and investigating their causes, the C.A.A. has reduced their number to a minimum.

Here are a few miscellaneous regulations. Most light planes are equipped with dual controls, but the dual set may be left connected only under certain conditions. An instructor will, of course, need the dual controls. When one of the seats is occupied by a pilot of Commercial grade or better or by a pilot with at least 200 hours and special permission, and when both control seats are occupied by pilots of Private grade or better, both sets may be left functioning. Anyone regardless of age or physical deficiency may receive dual instruction from a licensed instructor. A certificate with its attending age limit and physical exam is necessary to solo, however.

No explosives may be transported in a plane except when necessary for safety (as in the case of landing flares), when the plane is carrying mail, or when the plane is on a military mission. Liquor and narcotics may not be carried nor may anyone under their influence be carried in a plane except in cases of medical necessity. Nothing may be towed by a plane except by special permission of the Administrator. No object may be dropped from a plane except unconfined shot, sand or water. These articles are usually used as ballast for free balloons.

There we have the Civil Air Regulations which will concern us directly as pilots. There are many more covering qualifications for engines, propellers, schools, mechanics, etc., but the ones we have considered are most important for us.

(Aviation Lesson 7 in August MECHANIX ILLUSTRATED will be our first on Navigation. It will be "Maps of the Earth." Be sure to get your copy. Questions on this lesson will be found on page 144.)

Which comes first— Your second helping? or our second front?

YOU WANT TO SEE THIS WAR WON—and won quickly. You want to see it carried to the enemy with a vengeance. Okay—so do all of us. But just remember...

A second front takes food...food to feed our allies *in addition to* our own men.

Which do you want—more meat for you, or enough meat for them? An extra cup of coffee on your breakfast table, or a full tin cup of coffee for a fighting soldier?

Just remember that the meat you don't get —and the coffee and sugar that you don't get —are up at the front lines—fighting for you. *Would you have it otherwise?*

Cheerfully co-operating with rationing is one way we can help to win this war. But there are scores of others. Many of them are described in a new free booklet called "You and the War," available from this magazine.

Send for your copy today! Learn about the many opportunities for doing an important service to your country. Read about the Citizens Defense Corps, organized as part of Local Defense Councils. Choose the job you're best at, and start doing it! You're needed—now!

Contributed by the Magazine Publishers of America

EVERY CIVILIAN A FIGHTER

New Furniture From Old

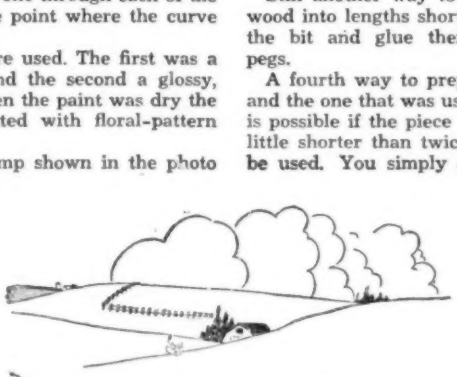
[*Continued from page* 121]

While the frame was being painted, the mirror was temporarily removed.

The mirror frame and the box were screwed to a piece of plywood so that the whole assembly became a unit. This facilitated handling and, while not essential, made it easier to secure the vanity to the door. Six screws were used, one near each corner of the mirror, and one through each of the long curved pieces at the point where the curve touched the door.

Two coats of paint were used. The first was a flat, white under-coat and the second a glossy, hard-drying enamel. When the paint was dry the finished job was decorated with floral-pattern decalcomanias.

The attractive table lamp shown in the photo was made from a scarred and dilapidated table. It had a circular top secured to a turned, vertical member supported on three legs. The vertical member was detached from the top, the remaining two legs and ornamental knobs were removed, and a section was sawed from the vertical member to become the upright of the table lamp. It is very important that the cut be a square one otherwise the lamp will look like the Leaning Tower of Pisa. Keeping the cut square is not always an easy matter, particularly when you are sawing a turning that tapers. It is a help to use some part of the turned design as a guide and revolve the wood as you saw so that you achieve a partial sawcut all around before cutting through.



"Have you been drinking, Pa, or is your nose lit up because you're leaning against that electric fence?"

After a suitable section had been cut, the next step was to prepare it for wiring. There are a number of ways of doing this. One is to rip the turned member in half, then gouge or rout a groove in each of the flat faces and glue the two parts together again. If this method is used, it may be necessary to make a simple cradle or jig to hold the work while it is being cut. It is also necessary to place a thin piece of wood or veneer between the two halves before gluing them up to compensate for the wood lost in the kerf, otherwise the finished job will not be perfectly cylindrical. This "sandwich" effect will not be apparent when the work is painted.

If, however, the work is not to be painted, the "sandwich" effect can be avoided by ripping the turning into quarters and planing off a little of the right-angle corner of each quarter. The resultant hole is a square one when the four parts are glued together, and the member will be cylindrical in section.

Still another way to do the job is to saw the wood into lengths short enough to be pierced by the bit and glue them together with dowel-pegs.

A fourth way to prepare the work for wiring, and the one that was used in the lamp illustrated, is possible if the piece of wood to be drilled is a little shorter than twice the length of the bit to be used. You simply drill from each end, first taking certain precautions to guarantee that the two holes will meet. It is inadvisable to attempt doing the job this way unless you have either a doweling jig or a drill press capable of taking the work. Getting the hole accurately centered and its direction started correctly are very important. The upright member of the lamp shown here is 13½" long and it was drilled with a bit 7½" long. It is well to clamp the work low—as close to the floor as possible—so that you can get on top of it and exert maximum downward pressure. This is necessary because when drilling with the grain of wood, the threaded point of the bit will not pull the bit along as well as when drilling across the grain.

The base of the lamp can be turned from scrap wood, or some suitable part of an old piece of furniture can be used as was done in the present case.

The upright member and the base were held together by glued-in dowel pegs, as shown.

The Navajo "night chant," a ceremony used to cure disease, requires years to learn, costs $200 to $700.

Two thousand hibernating frogs have been shipped to England by the Red Cross for medical study relating to war injuries.

Rainbow Man

[*Continued from page 49*]

the steps become a clear white, a wide red swath is painted about a foot above the rail and the rail itself is colored a bright blue, the corners on landings are painted white to discourage flinging of refuse and consequent tumbles because of orange or banana peels.

It's a tricky business, color. There are no set formulas which can be applied to situations. Each problem is a separate one and must be tackled by itself. And that's because different people, different nationalities, different climes react differently to the same colors.

If the color engineer should find twin factories, one in Georgia and one in Connecticut, for example, with the troubles duplicated in every particular, he would find that while one solution might work wonders for the northern plant, the same method would be disastrous in the south.

That's because people from Dixieland do their best work in an atmosphere of soft, cool colors like blues and greens. But up north they react more favorably to rich, vibrant hues of red, maroon, purple. The explanation lies in the climate—southerners want a cool environment to offset the heat; northerners want warmth.

But even this apparently general rule has its exceptions. A Wisconsin plant found that its workers, predominantly Swedish and Norwegian, put forth their best efforts in an atmosphere of blues and greens. They stemmed from the Polar regions, where the ultra-violet rays of the sun form a blue image in the retina of the eye, creating a preference for tints of the blue family.

A Midwestern factory, set down in the heart of a Slavic colony, found production increasing markedly after the plant had been done over in reds and oranges. Nearly all of the employes were of Slavic origin, a nationality that reacts best to those colors.

Nothing is sacred to the man who has harnessed the spectrum to industry. Look at the time-honored yellow ledger paper with its hallowed red and blue rulings. It's changing now, ever since a manufacturer ran off an experimental batch of pale-green paper with rulings of soft brown and dark green. Bookkeepers found that the new paper cut the glare of reflected light and were much less jumpy on the eyes.

So in a hundred ways, in offices, hospitals and factories, the rainbow is being put to work.

Male woodcocks in spring mating display, perform a "sky dance" for the females—they spiral high into the air, then tumble like a crippled plane.

An oceanographer says that the Pacific Ocean is two feet higher on the Australasian side than on the American.

A British writer says that birds regard airplanes in four different ways—with indifference, curiosity, belligerence, and fear.

Raiding with the Rangers, 'cross country scouting, front line dispatch riding . . . those are some of the motorcycle jobs that call for red-blooded riders with daring and courage, cool heads and resourcefulness.

In flashy, flexible performance on a dozen battle fronts, Indian Motorcycles are backing up these riders with all of Indian's famous power and speed and sturdy dependability. The soldier who rides an Indian knows there's no safer motorcycle built.

And you'll know it, too, when you ride the great new Indians that will be yours for good times and economical transportation after this war. In the meantime, let your Indian dealer help keep your present motorcycle in fighting trim . . . and ask him about his reconditioned "buys".

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BUY WAR BONDS NOW

★ ★ TO BUY AN INDIAN LATER ★ ★

Cut Metals The Easy Way

[*Continued from page* 111]

been filled with two length of 1½" angle iron, obtained and cut from an old bed spring runner. These angle irons are fastened to the board with the same bolts that hold down the mandrel (shown in a photograph). Thrust bearings should be slipped over the ends of the shaft in order to prevent endwise motion of the motor table.

When bolting the mandrel down, it should be in such a position that, when the cut-off wheel is in place, there is a ½" separation between the cut-off wheel and the table. The motor which should be approximately ½ horsepower, is bolted to the table in such a position that the table is slightly off balance and tends to tilt down at the mandrel end. The amount of this downward force should be about five pounds at the front end of the motor table and can be so adjusted by use of a spring balance. Two 3½" V-pulleys are fitted on the motor shaft and two 2" pulleys on the mandrel. Using two V-belts instead of one avoids excessive belt tension which would promote unnecessary friction and decrease the available power for cutting.

Due to the high speed at which the cutting wheel turns, it is absolutely imperative that a guard be provided to protect the operator. This guard can be fabricated from two sheet-iron faces cut as shown, and a metal band. The whole should be screwed together using 4-40 tap and screws. This guard when complete is screwed to the tilting table as indicated, with the mandrel end extending through its center. Screwing this guard together enables one to remove the front face when it becomes necessary to replace or change the cutting wheel. The handle is an old gear shift lever, its end threaded and bolted to the front edge of the table.

The drill press vise, which holds the work, is bolted or screwed in position. The exact location of this part is left to the discretion of the builder as it will vary with the type vise used.

Although any 8" abrasive cut-off wheel will give good performance in this machine, the best for general shop work is the Norton NOR 46 (8" dia. by $\frac{1}{16}$" thick). When purchasing these wheels make sure the center hole is the proper size for the particular mandrel you are using.

Vicious tiger sharks are captured alive by piercing them with steel-pointed spears which shoot an anaesthetic into the struggling fish, render them unconscious in 60 seconds.

Every cubic mile of ocean is estimated to contain 4,000,000 tons of magnesium; it is now believed the most promising source of this metal for the United States.

Federal chemists say that sugar-cane "mud" that results in the cane milling process is a possible source of about 6,000,000 pounds of wax a year.

QUESTION BOX

The answers to these questions will be found in Aviation Lesson 6—Air Traffic Rules, which will be found in *The School Shop* beginning on page 100. When you have mastered thoroughly this lesson and the previous lesson in June MECHANIX ILLUSTRATED, you will have all the knowledge necessary to pass the Private Pilot written exam in Civil Air Regulations.

1—What are the rules for right-of-way in the air?
2—Define *ceiling. Visibility. Contact flight.*
3—What are the rules for minimum altitudes? Minimum ceilings? Minimum visibilities?
4—A plane flying at night must carry what lights?
5—In radiotelephony, what does the signal PAN indicate?
6—What are the four grades of pilot certificates? What are the two special ratings?
7—Can a Student Pilot carry passengers? Can a Private Pilot carry passengers?
8—Can a Private Pilot receive pay for flying?
9—What do the symbols *NC* on a plane indicate? *NR? NX?*
10—What is a *Registration Certificate?* An *Airworthiness Certificate?*
11—May a plane tow a banner for advertising purposes? Explain.
12—May a plane drop leaflets for advertising purposes? Explain.

Vest Pocket Crystal Receiver

[*Continued from page* 126]

the condenser shaft and soldered. Then the tuning knob of binding-post size can be fitted to the shaft.

The phone condenser may be left out if desired, but will be found advantageous in improving quality. Solder a fountain-pen clip to the back side of the can, near the top, as shown.

This receiver may be carried constantly in the coat pocket. Sling a short piece of insulated wire over the shoulder, under the coat. When desired it can be plugged into the antenna jack, the phones inserted into their jacks and the receiver tuned to the station.

This is a fool-proof miniature receiver that will find a place in the office, on the street or even in an open car. There are no batteries to run down and reception will be clear and loud within a short distance of a powerful broadcasting station.

Soldering Iron

[*Continued from page* 107]

with it, model machine guns with ¾" barrels and ¼" mounts were soldered together of separate parts with the most accurate precision.

An old soldering tip was faced off on the end to leave a ¼" flat surface. Then a hole one size smaller than No. 8 wire was drilled down through the center. A piece of No. 8 copper wire was slightly tapered at one end and this taper driven down into the hole in the tip to make a wedge-tight fit. The wire was then bent to the desired curve for handy soldering.

Railroad researchers estimate the cost of stopping a modern streamliner at $1.69.

Before The P-38

[*Continued from page 72*]

Our airplanes are not precise imitations of birds, but they come fairly close. The bird wing is a propeller as well as a wing. For purely mechanical reasons it is better to separate these two functions when building on a size scale far surpassing that of birds. But all such "modern" devices as Fowler flaps and slotted wings and even the tail brake of the German dive bombers can be found in the bird wing. As a matter of fact, scientists are convinced that we can still learn a great deal from the study of bird wings and bird flight. Institutions devoted to such study exist in several countries. The bird flies more efficiently than our airplanes, in that it gets more miles per hour out of less effort. We are trying to find out why.

And there are other special studies going on, concerning the living beings that started the whole thing: the insects. There can be no doubt that the insects can fly better than anybody or anything else. They do not fly faster (that famous story of a speed of 818 m.p.h. attained by the male bot fly is so much hot air) but they do fly better. They can hover near a flower completely motionless, save for the movement of the wings, and can dart away, changing from hovering to top speed (between 20 and 30 m.p.h.) almost instantly. They can stop almost as suddenly as they go ahead and some observers claim that they can fly sideways or backward if they want to.

One bird which can hover and which flies more like an insect than like a bird is the tiny humming bird. By means of motion picture films the number of wing strokes has been shown as high as 200 per second. A sparrow and a swift can each go up to about 10 or 11 strokes per second, an owl to five, a blue jay to three, while the large stork makes at best two per second and the stately pelican never more than one.

It is a different method of flying, and it seems that the wings perform a different movement. Flying birds usually describe something like a tilted figure 8 with their wing tips when flying, the humming bird, when hovering, seems to describe a circular movement. Hovering insects do about the same. It will require many more hours of observation and many miles of high speed film before man can learn all these secrets of Nature.

As far as the principle goes, the hovering of insects and humming birds compares with the principles of helicopter flight. It amounts to the steady manufacture of a downward stream of air. But it is not so much the principle that is baffling. It is mainly a problem in stability of flight . . . and here again we may be able to pick up a few useful tricks evolved by Nature millions of years ago.

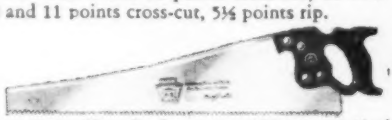
A synthetic resin sealer now on the market provides a good protection for fishing rods, as well as protecting all fishing gear against rust and corrosion.

SAWS FOR THE WAR EFFORT

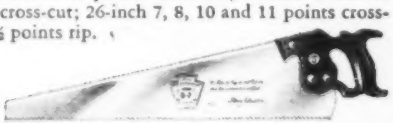
In accordance with WPB limitation order, Disston is manufacturing four Disston Hand Saws and two Keystone made-by-Disston Hand Saws as shown below . . . If you are doing essential work, see your Hardware Dealer about one of these fine saws:

D-43 Victory—Lightweight Straight-back pattern, the finest saw in the Disston Line. Made in 26-inch 7, 8, 10 and 11 points cross-cut, 5½ points rip.

D-23 Lightweight Straight-back pattern. Always popular with saw users demanding quality and workmanship. Made in 24-inch 8 and 10 points cross-cut; 26-inch 7, 8, 10 and 11 points cross-cut, 5½ points rip.



D-8 Medium weight, Skew-back pattern, "The Saw Most Carpenters Use." Made in 20-inch 10 points cross-cut; 22-inch 8 and 10 points cross-cut; 24-inch 8 and 10 points cross-cut; 26-inch 7, 8, 10 and 11 points cross-cut, 5½ points rip.



D-7 Lightweight Straight-back pattern. Universally popular moderately priced Disston quality. Made in 26-inch 7, 8, 10 and 11 points cross-cut, 5½ points rip.

K-6 Challenger, a popular priced Keystone made-by-Disston Skew-back saw. Made in 26-inch 8 and 10 points cross-cut, 5½ points rip.

K-4 Airmaster, a popular priced Keystone made-by-Disston Straight-back saw. Made in 26-inch 8 and 10 points cross-cut; 5½ points rip.

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HENRY DISSTON & SONS, INC.
708 Tacony, Philadelphia, Pa., U. S. A.

Miracles Of Chemistry

[*Continued from page 67*]

plastics of certain types admitting healthful ultraviolet rays that glass excludes.

There is no sharp dividing line between plastics and coming synthetic textiles. Nylon, whose molecules come from coal, air, and water, is familiar as a silk substitute in stockings. Yet it is also a plastic out of which they are making bristles and printing type. Nylon window screens are puncture proof and never need painting.

Men's hats made of synthetic fibers will be rain and soilproof. They will keep their shape and last longer, and the same naturally is true of women's headgear if such an end seems desirable. Suits will have the press built in. Chemicals such as sulfamic acid will make clothing fireproof. Moths won't tackle such garments, or rugs and upholstery made of unpalatable molecules. Illustrated books may well be printed photographically on sensitized paper-thin plastics, avoiding the loss of detail inevitable in the best half-tone processes.

Shoes can be made of porous plastics, fitting perfectly because they're shaped in one piece upon a cast of your feet that you leave with your dealer. This shine is built in; a damp cloth removes all dirt. Woven plastics can pump cool air past the feet in hot weather. Plastic whisk brooms generate static when brushed over garments and hold on to every dust particle for dear life.

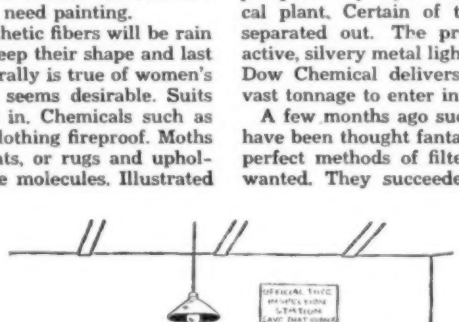
Cheapness enters the picture, as it always does when chemists get down to business. It is quite probably that synthetic fabrics for some uses will be cheaper to use and throw away than to launder. You can visualize a bed with a concealed roller under the foot. Pull up a new pair of sheets each time the bed is made, throw the old ones away and forget about washing and ironing. Table cloths, fancier in design, will be more permanent but such tragedies as gravy spots, chocolate sauce, and fruit stains will come out with soap and water, applied to a cloth whisked over the surface. Emily Post herself would never guess what happened between the cup and the lip.

By now you're wondering where all the cheap molecules are coming from to make these new products, and how chemists are going to change them beyond recognition. Almost anything that is cheap and abundant enough will satisfy the chemist.

The most inexhaustible material on the face of the earth is sea water. Let's start there. That is just what chemists are doing—and we mean *starting*.

Something like 300,000,000 gallons of sea water is pumped every day through the pipes of one chemical plant. Certain of the swarming atoms are separated out. The product is magnesium, an active, silvery metal lighter than aluminum which Dow Chemical delivers to airplane factories in vast tonnage to enter into Flying Fortresses.

A few months ago such an achievement would have been thought fantastic. Chemists first had to perfect methods of filtering out the atoms they wanted. They succeeded brilliantly. The seven seas contain in solution practically all the atoms and molecules found on land. Some, of course, are more concentrated than others. But here is a fabulous source of raw materials that we have only begun to tap.



"You can get up now, Jackson, the car you were working on drove away thirty minutes ago."

Coal and petroleum are such concentrated sources of hydrogen and carbon atoms that it is almost criminal to burn them as fuel. Food flavors, aspirin, sulfa drugs, synthetic rubber, dyes, explosives, solvents, silk stockings, and thousands of other things come out of coal and petroleum when chemists modify their molecules. More and more, oil and coal are becoming chemical industries. Foresighted Englishmen are looking toward the end of the war when British coal reserves will supply the raw materials for a thousand manufactured products to revive international trade. In our own country, DuPont this year will use 100,000,000 tons of coal in molecule factories turning out military essentials. Add other molecules to the hydrogen and carbon of coal and you can make almost anything.

Air and water yield important molecules too—nitrogen, hydrogen, oxygen. And we will have molecule farms: agricultural plants and wastes for chemical raw materials. Solar energy is captured in all forms of plants, and stored in various organic molecules awaiting chemical combination or release.

Minerals, including the rarer ones such as titanium, molybdenum, tantalum, vanadium, will

Miracles Of Chemistry

be available in larger amounts thanks to new methods that make it possible to recover metals from poor ores. What the chemists do, in effect, is to hitch chemical "balloons" to the metal molecules, lifting them to the surface of a flowing mixture of water and pulverized ore. These flotation methods make it profitable to separate metals that may be present scantily in ores mined, let us say, for their silver, copper or other content.

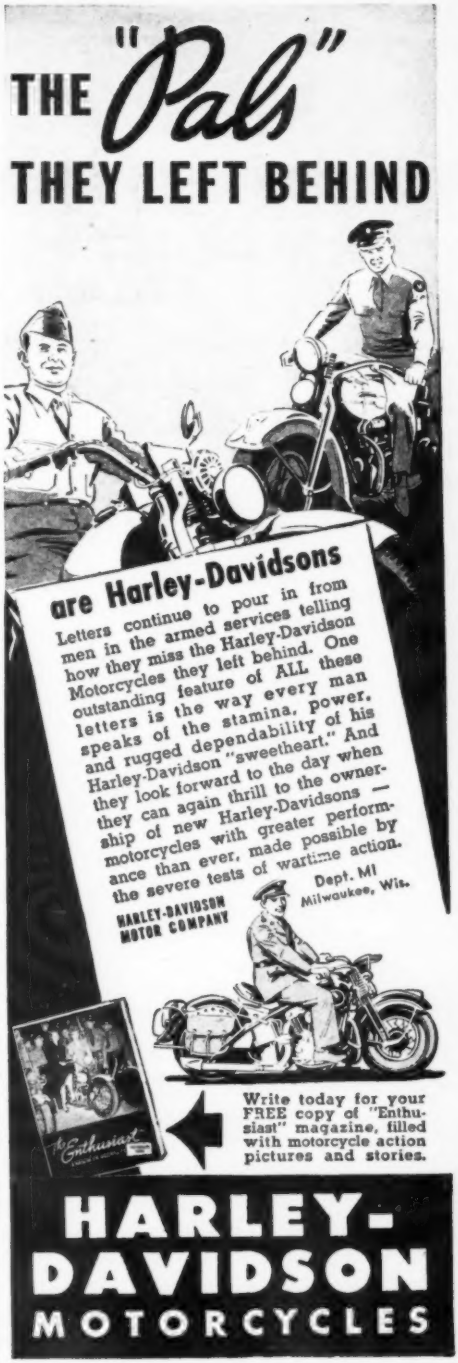
Tomorrow's chemists in all the lands of earth will have abundant molecules to work with, saving a few inequities in the distribution of metals. What is equally important, they will have new methods of forcing and cajoling these molecules into the shape of things to come—making the molecules dance excitedly, snipping off an atom here, adding a couple there, until the result is something new under the sun.

High octane gasolines as developed by Socony-Vacuum and Houdry Process Corporation lift a curtain on what may be expected in the field of catalysis. A catalyst is a substance that speeds a chemical reaction—the dance of the molecules—without itself being changed. Socony uses a secret catalyst which looks like tiny beads, Houdry a catalyst of aluminum silicate, which so increases efficiency in cracking petroleum that the resulting gasoline is some 25% more powerful than any previous known. Right now it's helping American fliers to establish astounding margins of victory on the fighting fronts, and after the war it will give you an auto fuel good for some fifty miles per gallon.

Even so, we have hardly started to make full use of catalysts. It is to be expected, in the orderly process of chemical advance, that some day we can do away with the gigantic boilers, the high-pressure apparatus and complicated equipment now used. Let catalysts wheedle molecules into reactions, instead of squeezing, superheating and blasting them as we now do, and the industrial silhouette with its vast stills, smokestacks, condensers and the like will be greatly simplified. Catalysts may well be different from anything we have known. Radiant waves have breathtaking possibilities. Kin to those spewn out by broadcasting stations, they harry molecules into frantic activity by radio bombardment. They plan to make "impossible" reactions possible and have staked off a scientific corner of their own called "chemotronics." Supersonic waves, which are sound waves too high in frequency for human ears to hear, also stimulate certain chemical activities.

Some day we will have to get our fuels from sources other than oil wells and coal mines. Some chemist, perhaps a lad now dropping zinc into hydrochloric acid just to see what happens, will eventually leave the high school lab and devise a cheap method of unlocking oil from the oil shales of which this country has immense reserves. The present handicap is cost. Then again, our fuels may take such liquid forms as have been

[*Continued on page* 148]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Miracles Of Chemistry

[*Continued from page* 147]

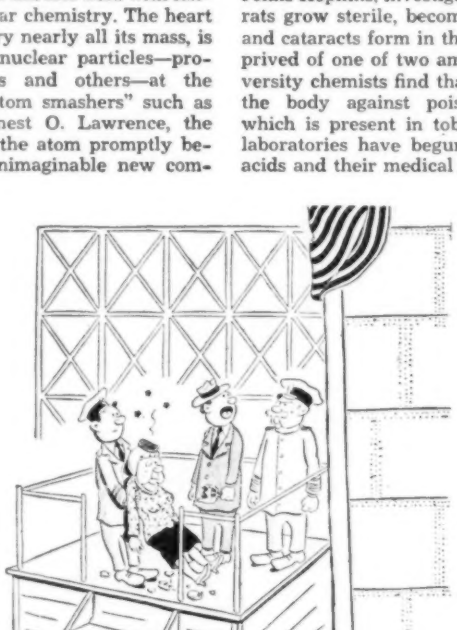
pioneered by Dr. Ernst Berl of The Carnegie Institute of Technology. He has produced super gasolines from corncobs, molasses, and other farm products.

Synthetic rubber is a typical product of polymerization. Broadly speaking, this is a linking together of similar molecules into giant molecules or chains. Here, too, chemistry has hardly taken its first faltering steps. Still another field with fantastic possibilities is nuclear chemistry. The heart of an atom, containing very nearly all its mass, is the nucleus. By hurling nuclear particles—protons, neutrons, positrons and others—at the nucleus, as is done in "atom smashers" such as the cyclotron of Dr. Ernest O. Lawrence, the nucleus is disrupted and the atom promptly becomes something else. Unimaginable new compounds may become possible when these bombarding particles become available by the ton.

Your health becomes more and more a chemical problem. Everybody now knows the miracle cures worked by sulfa drugs. Yet these are probably poor t h i n g s compared to what are coming. In scores of laboratories chemists are hooking new molecules to sulfa chains. Atabrine and plasmochin, two synthetic organic chemicals, replace quinine cornered by the Japs and by p r o t e c t i n g troops against malaria rank with guns and ships as military weapons. Discoumarin, a recent chemical discovery, prevents formation of blood clots and makes operations safer. Injections of kidney extracts reduce high blood pressure amazingly. Propylene glycol, a cousin to antifreeze solutions, when sprayed into the air renders influenza bugs harmless. Pentothal sodium is a new anesthetic that puts one to sleep by a shot in the arm. Penicillin and gramicidin are antiseptics made from soil bacteria that appear to be a hundred times as potent as sulfa drugs. The list is endless, yet is just beginning.

A familiar salt containing fluorine is a new chemical hope against tooth decay. Adding it to drinking water in infinitesimal amounts appears so to harden growing teeth that cavities never develop. The money we spend for vitamin pills may some day go for a few cents worth of chemicals that enable the body to make all the vitamins it needs through its lifetime. Dr. Gustav Martin of the Warner Institute for Therapeutical Research has developed a pleasant tasting syrup which, at a cost of $2, enables the intestines to synthesize the B vitamins.

Amino acids are food elements more important than vitamins. They occur in protein foods. At Johns Hopkins, investigators have discovered that rats grow sterile, become bald, their teeth decay and cataracts form in the eyes when they are deprived of one of two amino acids. Fordham University chemists find that these chemicals protect the body against poisons, including pyridine which is present in tobacco smoke. One or two laboratories have begun to prepare pure amino acids and their medical use in treating many obscure diseases is just beginning.



"But you said to christen the old battlewagon!"

Foods can conceivably be prepared from coal and wood molecules, or petroleum. Many of the foods we now eat are satisfying in bulk but lacking in chemical micro-nutrients because soils have been exhausted. Analysis of soils and restoration of vital chemicals may be the beginning of a super race. It may become easier to produce vital foods by raising them without soil, letting the roots d e r i v e nourishment from trays of chemical solutions.

C h e m i s t r y is, of course, the key to the light metal age we are just entering. Aluminum and magnesium (the latter coming, as we have seen, from sea water) will eventually force every railroad in the country to rebuild its rolling stock. With a light metal freight car weighing only one-third as much as present steel varieties, it just isn't in the cards that railroads can compete economically on the old basis. Trucks, buses, automobiles, window frames, typewriters, airplanes, merely begin to give you an idea of the enormous backlog of demand being built up for light alloys. Yet steel is not giving up without a fight. Metallurgists are increasing its tensile strength and corrosion resisting qualities and foresee unsuspected uses—stainless steel roofs for houses, for instance (colored if you wish) that never need repair.

Look for astonishing developments in glass as

Miracles Of Chemistry

well. Already we have glass that can't be broken, glass that can be sawed like wood and is strong as steel. Glass fibres can be spun into silky fabrics, and hold captive air bubbles so that they are lighter than cork and a first-rate insulators. A glass that will not glare has been announced, and glass is making superior sutures for sewing up surgical incisions.

Photographers will find that they can take better pictures in dim light, thanks to a chemist's discovery that etching a lens surface with hydrofluroic acid deposits a thin film of calcium fluoride that permits about 10% more light to pass through the glass instead of being wastefully reflected. Film emulsions will be improved immeasurably in speed and lack of graininess. Chemists have derived a substance from mustard oil so potent that a pinhead speck of it will make a ton of ordinary emulsion supersensitive. Various chemical dyes are proving capable of regulating emulsion speeds to any desired degree. Tomorrow's candid camera can be no larger than a fountain pen, loaded with a narrow strip of fine grain film that can take a dozen perfect negatives to the inch. Ordinary snapshot cameras will be developed to the point where the amateur gets natural color prints at the cost of black and white.

When you stand on the shore of the Atlantic on Long Island you can hardly hope to see across the ocean to London. Anyone who attempts to predict chemical advances of the next few decades is in somewhat the same position. Chemistry is a vast ocean in which we have hardly got our feet wet.

Once in awhile a tiny wavelet of that ocean rolls in a little farther and we get a faint inkling of what lies beyond. Such a wavelet was the recent report that a Norwegian factory making a queer chemical known as heavy hydrogen had been blown up. Heavy hydrogen, which has twice the molecular weight of the ordinary variety, is reported to give a terrific power to high explosives when combined with other chemicals, and presumably the Germans were using the plant for that purpose.

On the other hand, another wavelet is the report by Dr. Arthur W. Hixson of Columbia University that chemical experiments now in progress give every hope of nullifying, rendering inert and useless, explosives as they are now known.

In wartime chemists are not free to tell everything they know. But it all adds up to a startling hint of things to come!

At the siege of Paris in 1871, the French used the young invention of photography to attach photographed documents in miniature to carrier pigeons, for sending information outside the city.

Spending more than $6,000,000, Brazil is reclaiming the Fluminense Lowlands near Rio de Janeiro, changing unhealthy swamp country into good farm land.

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Why Lop-Sided Airplanes?

[*Continued from page 45*]

of 880 HP. Nothing much has been revealed about its performance, but there can be no doubt that it performed well enough to eliminate the doubts harbored by the many critics of the idea. One of the main objections had been the statement that it would be very difficult to fly straight ahead with such an asymmetrical plane. The first model seems to have disproved this contention. That it would, should have been obvious, because normal two-engined planes have little trouble flying in a straight line with one engine out of action, and a twin-engined plane with one engine out of action is much more lop-sided than a Blohm & Voss, because the distances involved are longer.

The new model which is said to be constructed in large quantities in Germany at the present moment—unless the RAF got the assembly halls of Blohm & Voss—is known to be equipped with a BMW 14 cylinder "twin radial" of 1,600 HP. The weight is reported to be about 9,700 pounds, the top speed just short of 300 m.p.h. The first and secret model is said to have been about 60 m.p.h. slower than the present type and probably did not weigh more than 8,400 pounds.

The Blohm & Voss 141-B is purely a pursuit plane, with several machine guns in its nacelle, said to be able to fire through wide cones both fore and aft. The type and number of guns is not reported.

It is not possible to make any predictions about the performance of this particular plane, or about the future of the assymmetrical airplane in general. But there were good reasons for trying it and the experiment made by the *Luftwaffe* at its own expense should provide a valuable lesson, valuable even if it should turn out to be negative.

Commandos Of Mercy

[*Continued from page 43*]

the enemy. Whenever possible they make use of the terrain for concealment.

A complete mobile surgical unit comprises fourteen trucks, seven of which are carefully designed operating rooms which permit surgeons at the front to have all the facilities of a well-equipped civilian hospital. Other trucks carry X-ray equipment, sterilizing machines and medical stores. These units roll with the mechanized forces. The Medical Corps, in fact, goes anywhere any other unit goes—by plane or hospital train, by parachute with paratroops, mounted with the horse cavalry.

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The Man Who Stayed In Bed

[*Continued from page 62*]

connection. The mechanical dog had photocell-eyes, and followed Mr. Hammond about at the blink of a flashlight. Its official demonstration took place in 1913, in the austere presence of a group of U. S. military men, headed by General E. M. Weaver, Chief of Coast Artillery. Each time the inventor turned his flashlight on, the dog kicked up its wheels, clanked across the room, and nuzzled its cold steel nose affectionately against Mr. Hammond's legs.

In addition to demonstrating the practicability of remote control, the emotionless, poker-faced mechanical dog settled a psychological side issue. Biologist Jacques Loeb expressed satisfaction with the fact that it had decided the age-old discussion between poets and biologists, as to whether moths fly toward a flame because of reflex action, or heartfelt desire. The soulless mechanical dog, with its weakness for shining flashlights, gave the decision to the reflexes.

This unique dog show in Mr. Hammond's castle at Gloucester, was followed in 1913 by the first successful demonstration of a radio-controlled boat, the Natalia, another of his inventions. While the somewhat wide-eyed officials looked on, the trim Natalia maneuvered about the harbor, guided only by radio waves from shore. But its inventor was not satisfied until he had controlled it from another boat, then from an airplane. Ironically, this demonstration took place only a few hundred yards from the reef of Norman's Woe—the scene selected by Longfellow for his poem, The Wreck of the Hesperus.

Next came radio controlled torpedoes; first running only a few inches below the surface of the water, then a yard, then the full eighteen foot depth. Navy men were a bit skeptical at first. What would happen if the enemy sent out their own radio control signal? Could they ward off the torpedoes? Inventor Hammond allayed these fears with a mechanism like that of the mechanical dog. He built torpedoes that had a great fondness for enemy radio signals. If the enemy radio tried to "muscle in," the torpedo would lick its chops, head for the enemy vessel sending out the signal —and blow it to pieces. It had the heart of the mechanical dog, but it played a lot rougher.

About thirty years later, following the Pearl Harbor attack, the Japanese military proudly announced to their people, that one of the U. S. battleships they had sunk was the Utah. They did not add that it was a radio controlled target ship. Like the Iowa and the Stoddert, it was operated by John Hays Hammond, Jr.'s remote control system, first tested in the tin dog and the little wooden Natalia.

Like inventors in fiction, Hamond's boyhood was well packed with thrills and the unusual. His father was a world famous gold mining engineer who revolutionized the entire industry by developing deep-level mining technique.

His engineering methods and ideas brought untold fortunes from thousands of feet beneath the earth's surface. To make the story even more colorful, the mines were located in South Africa, and many of them belonged to the renowned Cecil Rhodes, for whom Rhodesia is named.

The necessary touch of drama arose from the rivalry between mine owner Rhodes, and the Dutch at Johannesburg. While mining engineer Hammond was thinking of deeper mines, Rhodes was fondly dreaming of uprisings that might be fomented among the Dutch. Rhodes slyly winked a political eye when Dr. Jim Jameson, noted British surgeon, led a 600-man raid on the Dutch. Dr. Jim and his band were captured by the wary Dutchmen, and Hammond, as a leader of an associated reform movement, was sentenced to death—although he took no part in the raid, and had no sympathy with it. But Hammond, like the typical fiction hero, escaped execution. He paid a fine, however, of $125,000.

To give the story a happy ending, he went to London, then to the United States, became one of our greatest financial leaders, and completed the job of raising one of the world's greatest inventors, John Hays Hammond, Jr.

The second article about John Hays Hammond, Jr., will appear in the August issue of MECHANIX ILLUSTRATED.

A Motorless Vacation

[*Continued from page 57*]

gradually learn the more intricate points of handling. You should not attempt to cruise where there will be a lot of rapids to run or portage around, but choose from those innumerable trips on which only small or easily run rapids will be encountered. Or you can select one of the all-river or small lake trips where smooth water will be enjoyed throughout. On the more strenuous cruises, however, it is advisable to have a guide along, not only to help handle the canoe through rapids and over portages, but for his knowledge of the route and country.

Wages for a good man run from $7 to $9 a day plus his keep. One guide can look after the usual party of two on the average trip, two will be required for a party of four, and so on. Outfitters report enough older guides are still available. The charge for a guide's services, food for him and a party of two, a roomy 20 ft. canoe, tents, air mattresses, sleeping bags, cooking gear and every-

A Motorless Vacation

thing necessary, is about $17 a day, or $8.50 a day per person. In some sections, where there is no outfitting post, independent guides make a practice of supplying everything along with their services—all but the food—for $7 a day.

While most cruises have been laid out so there will be no extra charges to consider these should be inquired about. A truck or motor boat may be required to transport your party and outfit to some point from which a certain cruise can be advantageously started, to avoid a day's paddling through perhaps uninteresting country. Cruises often follow a circuitous route that brings you back to the outfitter's place, but on some a truck will have to be sent out to bring you in and the outfit back. The distance, of course, determines the amount of the extra, but $15 can be considered a typical charge. On other cruises a carry may be required to get a considerable distance from one lake to another, and a settler doing such work for parties may charge $5 or so for the use of his team and wagon. Invariably the outfitters have established reputations to maintain, however, and will not overcharge you. The guides are licensed by their state or province.

As to clothing and personal things required, you probably have most of these if you've done any hunting or fishing. Choose your clothing with the thought that most days will be bright and sunny, nights always cool and often cold, and that you're bound to get a few rainy days on most trips. Things not harmed by wetting, that can be readily tubbed out in camp are ideal for both men and women. Easily washed denim dungarees or duck trousers with perhaps a heavier pair; a long-sleeved, lightweight shirt and a woolen one; regular summer underwear with, for far north sections, a light woolen suit as a change; a leather jacket, mackinaw or sweater for cool evenings and a poncho or oilskin for protection from showers; an old felt or other hat with a brim; a couple of pairs of woolen socks; canvas sneakers or canoe moccasins that wetting won't harm and a pair of heavier but not higher than 8-in. shoes for rough going ashore—each person's outfit of these can be packed in a waterproof dunnage bag. Odd things should include a small pocket compass, waterproof match safe, sun glasses, sheath knife, toilet articles with a couple of towels, a small first-aid kit, yarn and thread with needles for making repairs to clothing, topographical or other maps of the section or route, secured in advance of your trip or from the outfitter, smoking things, your camera with a supply of film and, of course, your fishing tackle. The outfitter should supply, in addition to the main parts of the outfit, such indispensables as spare paddles, a kit for emergency repairs to the canoe and a light towline.

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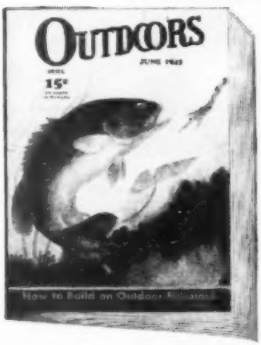

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AT ALL NEWS DEALERS

What Is A Battle?

[*Continued from page 53*]

In doing this he has achieved maximum diversion of the enemy forces—but his own are somewhat dispersed—except that he has not used his main forces yet.

Now look at Map 5.

Bewildered by these rapid and seemingly scattered blows, the Green forces are overwhelmed by prong "C" which, its task finished, swiftly concentrates with prong "B" and overwhelms the Orange forces at "B."

The combined forces of Prongs "B" and "C" now turn eastward and effect an enormous encircling movement breaking through the Blue fortifications at their weakest point, and, continuing on to join up with the original retaining forces at "A," completely encircle the Blue main body. While this encirclement is taking place, the Red main force has launched its main attack through wooded valleys and hills that were thought to be invulnerable and has struck heavily and decisively at the main body of the Blue forces. Successive detachments from the Blue forces have shrunk its strength to some 2 million men. The Red commander has concentrated nearly 3 million men against them after having successively defeated the Green and Orange armies of a million men each.

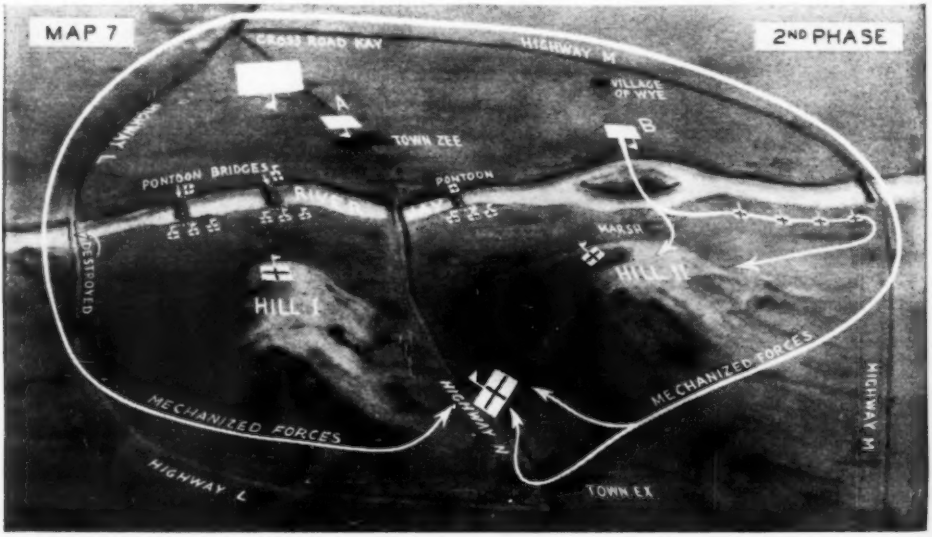
The great battle is almost over before it started, because victory was nine-tenths won before the first shots were fired. Victory was assured by successive and energetic use of the simple rules of war. Skilled generals in all ages have won battles, many of them probably without knowledge of even the names of the principles of war. But in all cases they were natural fighters who used common sense—which is the same thing. Our own General Nathaniel Bedford Forrest was this type of fighter. He condensed the wisdom of war into one striking phrase, usually misquoted, in which, explaining how he had won the battle of Murfreesboro, Tennessee, he stated that he "took a short cut and got there first with the most men." The principles of war simply show each and every factor necessary to the achievement of "getting there first with the most men."

These principles are like sharp tools in the hands of a skilled carpenter. By their proper use a really skilled general can often save the lives of his men and win wars at small cost before ever he arrives on the field of combat. But most wars are won by winning battles. Most wars in history have been decided by the outcome of a single battle. The moves preparatory to battle are called *strategy*. The winning of battles is a science in itself, which is called *tactics*.

Now, let's see how a commander goes about the winning of the battle that shall decide this campaign. First study Map 6, which is a small section on the Blue territory shown in the previous maps.

The Red Commander has succeeded in mopping up all outlying elements of the Blue forces. His three prongs, "A," "B" and "C" have come together at Cross Roads "Kay" and have succeeded in driving the main body of the Blue forces across the River "Jay" where they have taken up positions on the opposite bank.

Put yourself in the position of the Field Marshal commanding the Red army. You have concentrated your forces after successfully chopping down Blue Army strength and you now face their



What Is A Battle?

main body for the final decision. The Blue forces, while depleted in strength due to too much dispersion, are still dangerous. They are doubly so, because they occupy a strong position, its front protected by a deep and wide river behind which they occupy high ground that will take heavy casualties to storm successfully. If you are a skilled commander, you want to spare the lives of your men, to gain your objectives at the least cost in casualties. A skilled commander will try to do this the easier way by using brains instead of the hard way by bloody frontal attacks.

Before the Red Commander starts solving his problem he has to have complete information about the disposition of the enemy forces and the relative position and condition of his own. The first thing is to get the latest data on the enemy. His chief intelligence officer is responsible for this task and is already at work classifying, collating and condensing all the various reports from spies, fifth columnists behind the enemy lines, and ground and air reconnoitering units.

While waiting for these the Red Commander receives reports from his staff on the condition of transport, food, munitions, medical and surgical supplies. Each of the commanders of his three corps give him this detailed information, supplemented by the reports of the chief engineer ordnance, quartermaster, medical, the signals and intelligence officers, the chiefs of artillery, tanks and aviation.

In ten minutes of brief reports he has a complete picture of the morale, the physical well being and the location of all his major units and the amount and location of his reserves in men and supplies. In other words he now knows his own strength and weaknesses, and just about *what* he can do. The next thing is to decide *how* to do it.

About this time the combined intelligence reports begin to come in. The picture of the enemy's strength and position begins to grow clearer by the minute.

The picture is substantially that as shown by the dispositions of enemy troops on Map 6. The line of the River "Jay" is held by enemy infantry, machine guns and light artillery with hill I strongly held by enemy heavy artillery. Hill II is more lightly held, the Blue commander evidently depending upon the protection afforded by its steepness, the marshes that protect its base, as well as the location of the enemy reserves behind it. Those still dangerous Blue reserves bother everyone present. All of them know that battles are usually won by the side that has the last reserves to throw in.

The Red Field Marshal then calls for suggestions from his subordinate generals, who command the three units which carried out the "A," "B" and "C" prong and encircling movements. Commander "A" suggests holding or "containing" the enemy all along the line from Bridge "L" to Bridge "M" and

[*Continued on page* 156]

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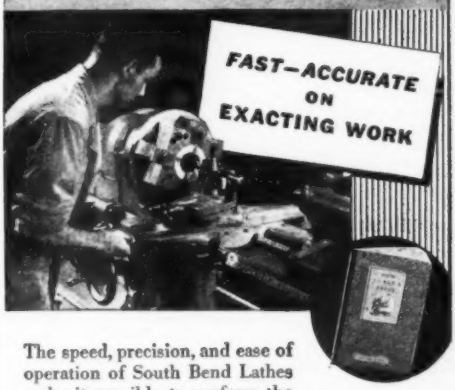

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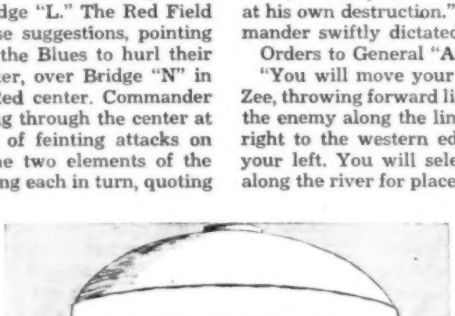
What Is A Battle?

[*Continued from page* 155]

attacking through the latter to outflank the Blues and strike at their reserves. The advantages of this are argued pro and con until Commander "B" suggests that instead of attacking through the region of Bridge "M," the enemy's right flank, that the main attack be hurled on the enemy's left flank in the region of Bridge "L." The Red Field Marshall vetoes both these suggestions, pointing out that it would permit the Blues to hurl their reserves through the center, over Bridge "N" in a counter attack at the Red center. Commander "C" now suggests attacking through the center at Bridge "N," under cover of feinting attacks on both flanks, separating the two elements of the enemy forces and destroying each in turn, quoting Jomini's theory of attack on the enemy center and spreading out on interior lines. The Red Field Marshal objects to this, pointing out that this would render useless the strength of his armored divisions which would be at disadvantage in the forested, hilly ground of the enemy center.

As the others grow silent the Field Marshal speaks up, announcing his own solution of the problem.

"I think, gentlemen, that this is a question of the application of Von Schlieffen's theory of concentric attack, based on Hannibal's tactics at the battle of Cannae, modified by the conditions as they exist here and now. The two weaknesses of the present enemy position will aid such tactics. His first weakness is that he is trying to hold a long river line by the discredited 'cordon' system i. e. a long thin line trying to hold every point at once instead of by a line of small advance detachments strongly supported and backed up by a mobile reserve. The second weakness of the enemy line is the lightly held marsh land below Hill II and behind the river island which will provide a screen for crossing troops under cover. Intelligence reports that there are routes through the marshland and that they have maps and guides ready for the troops. Hill II is more lightly held than Hill I due to the enemy's belief in the impossibility of successful attack through the marshlands. That should be the point of our initial attack, carried out in conjunction with dispersionary action all along the enemy front plus strong attack by our mechanized forces around the enemy right and left flanks, as Hannibal attacked with his cavalry at Cannae." The three generals studied the map as they listened ". . . and," continued the Field Marshal quietly, "also like Hannibal, we'll try to let the enemy himself connive at his own destruction." With that the Red Commander swiftly dictated his battle orders.



"It ain't fair—I'm 4-F and he's only 1-B!"

Orders to General "A," First Phase of Combat:

"You will move your two corps to the town of Zee, throwing forward light detachments to engage the enemy along the line from Bridge 'L' on your right to the western edge of the river island on your left. You will select three favorable points along the river for placement of sufficient artillery to cover the throwing across of three pontoon bridges spaced as nearly equidistant apart as possible. Across these you will send assault troops with instructions to gain the farther bank, and engage the enemy, arranging beforehand for the safe and speedy withdrawal of these assault troops in case of need."

General "A" looked up sharply as comprehension began to dawn upon him, but the Field Marshal was already issuing his orders to General "B."

Orders to General "B," First Phase of Combat:

"You will move your three corps to the village of Wye, sending forward dispersionary detachments along the river bank from the western end of the river island to Bridge 'M.' Your main forces will cross the river via the river island, attacking Hill II and seizing it, at the same time cleaning up all Blue forces on your left—after the enemy is engaged with General 'A's forces."

Orders to the Commander of the Armored forces and motorized infantry:

"You will send your 1st Armored Corps via Highway 'L' to cross the river, encircling Hill I and seeking out and holding the enemy reserve in the vicinity of the town of Ex. You will send your 2nd Armored Corps via Highway 'M' across the river to strike around Hill II and attack and hold the Blue reserves in the vicinity of the town of Ex, the two corps arriving as nearly simultaneously as possible. You will hold your 3rd Armored

[*Continued on page* 158]

Your Invention Clinic

[*Continued from page 12*]

Broken Drill Remover

David Twichell, Phoenix, Ariz., sends a design for a device which will electromagnetically remove broken drill pieces from holes. He says: "Have I overlooked some important mistake?"

ANSWER: *Frankly, we are unable to see how the device can work. Maybe you have omitted some of the details of its supposed operation. But you seem to have overlooked entirely the manner in which drills break in pieces of work. We would recommend you build the equipment you have designed (it is certainly simple enough); that you get a few pieces of metal containing broken drills and that you try your apparatus before you proceed with an attempt to patent it. It is our belief that results will be negative.*

Drafting Pen

Clarence M. Wittmann, Sharpsburg, Pa., submits a design for a new style of pen used by draftsmen for drawing lines. Because we believe that this invention holds considerable merit we are withholding details of its construction in accordance with our policy.

ANSWER: *We recommend that you consult your patent attorney immediately and have a search made on this improved type of pen. We are inclined to believe that you will have difficulty in protecting this design fully because the principle of the adjustment has been employed in other constructions. Nevertheless, you should have a search made and if your attorney believes the design can be protected, further action would be indicated.*

Portable Clothes Line

Mrs. S. M. Crawford, Salinas, Calif., sends an illustration and description of a portable clothes line, the nature of which is made clear in the answer.

ANSWER: *This is an item which is not suitable for production at the present time because it is made largely of strategic materials. Also, we do not think that it can compare for simplicity with collapsible clothes poles, some of which are so constructed that they can be made to disappear underground when not in use. One objection to your construction is that the unit is not speedily collapsible. A modification of the design would allow for this. The most important objection, however, is that the use of the unit is limited to those homes where a laundry has a door leading to a lawn or where a garage may be used to function partly as a laundry. We would recommend experimental work leading toward the development of a unit of greater simplicity, rigidity, collapsibility and portability.*

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What Is A Battle?

[*Continued from page 156*]

Corps as part of the main body in readiness."

Order to the Commander, Air Forces:

"You will make the necessary preparations for three successive concentrations of your attack and bomber forces, the first to be in support of General 'A's' attack; the second in support of General 'B's' attack and the third in concentrated attack against the reserve forces of the enemy."

There were questions answered from the three commanders, from the chiefs of supply, signal engineers, and medical corps; orders were swiftly despatched to all units and the various components of the Red Army began quietly to move upon their appointed tasks.

This was at midnight. An hour before dawn a message received from General "A" stated that his forces were in position, that the pontoon bridges were being thrown across the river under cover of his artillery fire. An hour later General "B" sent word of his readiness to attack via the river island. The armored force commander likewise reported, stating that the two prongs of his armored assault columns had crossed the river on the enemy's left and right flanks. The situation was thus as shown in map 6 herewith.

An hour later General "A" reported the bridges finished and his troops already engaged on the farther bank against the Blue forces. At dawn the Red aviation forces concentrated against the Blue objectives being attacked by General "A" on the ground.

With the coming of daylight the Red Field Marshal himself flew over the lines, noting that the Blue forces were being concentrated against General "A's" attacking forces which by now had crossed the river and were deploying on the enemy shore. And then the Red Marshal did a strange thing. He broadcast an uncoded wireless message reading as folows:

"To General 'A' aerial reconnaissance shows enemy concentrating superior force against you. Withdraw your troops from enemy held river bank."

The effect of this mesage was not long in showing itself.

See map 7.

The Blue forces along the river bank rapidly concentrated against the withdrawing Red troops, gathering around the pontoon bridge heads. The Blue troops holding Hill I moved down to support them. The Blue troops holding Hill II did likewise.

Immediately thereafter, the Red Field Marshal had a message dropped from an airplane ordering General "B" to attack Hill II. As the Red forces of General "A" safely withdrew across their pontoon bridges making deliberately ineffective efforts to destroy them, the Red Air force was ordered to concentrate against Hill II. In the meantime the armored corps commander reported that his two forces had gained contact and were engaging the enemy reserves near the town of Ex. The second phase of the battle was being brought to successful conclusion.

Waiting until large elements of the Blue forces had crosed the pontoon bridges and were advancing on the far side, the Red Field Marshal ordered a general advance, moving his own body down to annihilate the Blue forces between Bridge L and Bridge N and thereafter crossing the river, mopping up Hill I and striking at the Blue Reserve

near Ex. General "A" launched his assault through the enemy center, moving across the river at Bridge N hastily repaired by his engineers to strike at the Blue reserve near Ex. (See Map 8.)

General "B" swept across Hill II, sending a strong flanking detachment to clean up the Blue forces on his right and then concentrated his full force against the Blue reserve.

The Red air forces, meanwhile, in co-operation with the Red armored forces, were smashing at the Blue reserve which was so softened up by the time the full concentration of the Red Army arrived on the scene that little remained to be done save to accept the surrender of the remnant of the Blue forces.

The world hailed this victory as one of the greatest since the battle of Cannae. The Red Field Marshal smiled to himself, having based its principles on the battle of Cannae, where Hannibal had so decisively defeated the Roman legions of Varro.

In this article, Major Wheeler-Nicholson has attempted to give you a picture of what happens in a campaign and a battle. Next month, Major Wheeler-Nicholson will tell you the fascinating history of the development of battle tactics, from the time of the cave man and his club up to the mobile artillery and infantry of today. Don't miss this exciting article in the August MI: The Science of Tactics.

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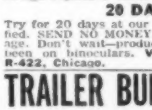

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Fifty Minutes Of Hell

[*Continued from page 38*]

comfortable now that the big guns were booming. He noticed that the commander, usually a very nervous man, was very calm. Then he was knocked off his bucket by a shell hit. The molten metal from the shell ran across the floor like lava and he stepped out of the way. Steam pipes were broken, electrical fires sputtered. Noise and heat from the steam were unbearable. He screamed over the phone to engine control to shut off the auxiliary steam line that went through the compartment to the whistle. Somebody on the bridge answered, "They heard you, Page," and in a moment added, "Secure and get out if there's nothing else you can do."

Several men who had walked out on the catwalk reported that flames were climbing up the tower. Robertson, a quartermaster third class, came through the opening from the catwalk and said, "I've lost my shoe, help me find my shoe." He stood there holding one bare foot off the hot deck, groping in the dark. Everyone helped him, even two commanders. The shoe was not found until next morning—under a body on the catwalk.

No direct hits had been scored on Batt II but flames, explosions and escaping steam threw the place into disorder. Bernard Wenke, S1c, the auxiliary helmsman, had been thrown from behind the wheel and lodged in between the bulkhead and the deck. He stayed there, keeping one hand stretched out to hold the bottom of the wheel. Not until flames from below made the deck almost red hot and set his pants afire did he move.

The executive officer pushed aside one of the men to look out the slot and drew back his hand covered with blood. For the first time he realized that men had been wounded. He called for a talker to relay the information to the bridge but got no answer. He felt in the darkness until he found a talker with phones on and dragged him to a standing position. Shaking him vigorously, he gave him the message to relay. The talker repeated the message over the phone, and the commander walked away. The talker slumped back to the deck.

Another officer came into the compartment. He walked to the quartermaster and said in a strained voice, "Feel my arm. It's been hit and I can't tell if it's still there. Go ahead, tell me." The quartermaster, still standing without his shoe, timidly reached for the officer's shoulder but then decided to find out the other way. He groped his way up the officer's leg until he came to his hip, then reached out for his hand. Finding it still there, he ran his hand up the officer's arm until he came to a gaping shrapnel wound in his shoulder. He reported what he had found and the officer said, "Thanks" and walked out.

During the entire action one of the lookouts standing by a slot kept repeating in a low voice: "Lord, I'm scared. Nobody has any idea how scared I am. How could anyone be this scared? My God, I'm scared." He said that over and over for about 10 minutes. Nobody thought it strange.

Men began crawling to their feet. Above the noise of the steam and the fire there rose excited voices. Men asked each other who was hurt, where was the ship damaged, how high were the flames. They speculated on their own chances of getting out. Occasionally they shot glances at the executive officer looking for help. He noticed but didn't know what to say. Finally he blurted out, "Shut up! I'll do all the talking in here!"

The talking stopped. Only the noise of the steam escaping could be heard above the gunfire below. Then the gunfire ceased and within a minute the steam went off. A new noise could be heard now—the moans of the injured and the dying. Pharmacist's mates went among them, injecting shots of morphine. From below came the noise of damage control parties, fighting their way through with hoses and extinguishers. Page grabbed the end of a hose that was passed up to him and pulled on it but it was too heavy. As someone walked past him into Batt II he called out, "Lend a hand, you fool!"

"Shut up, Page," said a voice. "That's Commander Gorton!"

"That's all right," said the commander, "I'm just one of the boys."

Working with the hose they extinguished the flames, then settled back in the darkness to await further action. The steel under their feet was still so hot that they were compelled to keep

FOR THE DURATION

If your copy of *Mechanix Illustrated* fails to arrive at your newsstand on time, please be patient. Remember that the nation's transportation system is all-out for war, and that distribution of *Mechanix Illustrated* to your area may often be delayed for several days to make way for movements of fighting men and their supplies.

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Fifty Minutes Of Hell

moving. Outside on the catwalk Page noticed a life jacket on one of the bodies periodically smoulder and burst into flame. Using steel helmets, the men scooped water from the compartment deck and poured it on the life jacket.

Damage control parties are formed when general quarters sounds. They go to their posts and wait for calls. When there is damage in their area they run to the spot with equipment that includes everything from fire extinguishers to monkey wrenches.

John Hagenbuch was a nozzle man on a hose party. While he was directing the stream on a fire in the shadow of the No. 3 turret, Chief Turret Capt. Bowman came out from inside and passed the word for the group to move along. He was ready to fire a salvo and the concussion would be tremendous.

Everybody evacuated the area but Hagenbuch. Standing at the head of the line, he had been forgotten when the word was passed. The guns lowered directly over his head and went off with a blinding flash.

Hagenbuch was thrown to the deck so hard he almost bounced. Slowly he staggered to his feet, temporarily blinded and deafened by the explosion. It had been so powerful that two planes were blown out of their catapults and into the sea.

As Hagenbuch groped his way back and forth, the guns went off with another mighty roar and again he was thrown to the deck. One of Hagenbuch's hose men saw the whole action and rushed out, lifted him to his feet and dragged him away from the turret as a third salvo thundered.

Thirty minutes later he was back on his feet, volunteering to climb to the top of a smoke stack to put out a fire there.

When John P. Buck left Athens, Ohio, and enlisted in the Navy he went in as an apprentice seaman. Several months later, while cruising the Pacific, the chaplain found that Buck could type. He got him a rating and had him placed on the muster roll as chaplain's yeoman.

Buck's duty at general quarters was after-battery lookout. Technically speaking, his post was in the surface, horizon and lower sky lookout station, situated just below the after main battery direction finder.

Buck leaned against the open door to the compartment and felt the warmth and silence of the night. Early in the channel run he had noticed the smell of the gardenias and had started to put on his gas mask before a talker on the bridge told him the smell was really just gardenias. About 65 feet aft from where he stood, Buck could see the big 16-inch barrels poked out over the starboard rail. He was lazily watching them when they suddenly fired a salvo with a deafening roar. Buck was picked up bodily and thrown inside the compartment. He

[*Continued on page 162*]

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Fifty Minutes Of Hell

[*Continued from page* 161]

heard his helmet fly off and strike a bulkhead 30 feet away, then roll around the floor. The explosion blinded him for about 15 minutes, during which time he groped on the floor and found his helmet. When he took it off the next morning he found it wasn't his. Whose it was and where it came from, he never learned.

Regaining his sight and finding that there was a lull in the battle, Buck offered to aid the pharmacist's mate in caring for the wounded. Before he could leave, however, the after battery once again opened fire, so Buck stayed where he was.

Over five miles away a 14-inch shell came screaming out the muzzle of a gun on a Jap battleship. Buck first saw it when it was about two miles away from him, looming larger and larger as a red dot in the sky. He knew it was going to hit and knelt down in the compartment.

The shell came through at exactly deck level. It tore through a slight coaming where the deck joins the hull, made two neat holes through a rim around a hatch leading below, and then crashed against the barbette of the after turret. There was a blinding flash and roar, and shrapnel rained down like cinders. Buck mentally marked turret No. 3 off his list. But when he went out to look he found that the turret was still there. Beside it was a yawning hole in the deck.

Looking over the starboard rail he saw a Jap ship racing up. He reported it but worriedly wondered how they were ever going to hit it with the after turret almost certainly out of action. Then he heard the secondaries open fire with a staccato bang-bang-bang, finally reaching the ear-splitting regularity of machine-gun firing, though in each of the little turrets men were flinging in shells by hand.

The after turret, meanwhile, turned slowly toward the approaching ship, now so close that the elevation on the barrels was almost nil.

Nobody was more amazed than Buck when the after turret fired. He had no idea it was still in action. Then he saw that the Jap ship had been hit almost point-blank by all three shells. There was a big flash where the ship had been and then smoking, bubbling water. In the few seconds before the Jap went under Buck had seen one of its turrets fly high into the air and the ship start to split in the middle. But it sank before it had a chance to fall apart.

The firing stopped and Buck left to help in the care of the wounded. At sick bay he found men stretched out on every available table with doctors and pharmacists' mates working over them while standing in four inches of blood and water on the deck.

He was sent with a doctor to the top of the superstructure to help the wounded men who had been cut off there. Only Patrick was still there. The doctor stayed with Patrick, giving Buck syrettes of morphine to administer inside the superstructure on the way down.

Descending on the inside of the tower, Buck found a man lying on one of the upper levels with one leg shot off. He took out his knife and walked over to a dangling electrical wire, cut it loose and wrapped it around the injured man's leg. He wrenched loose the shattered rung of a ladder and used it to twist through the wire, making a tourniquet.

On the next level down he felt his feet get tangled in something in the water on the deck. An officer came along with a flashlight and they discovered that his legs were entwined by someone's insides floating on the water.

He kicked himself loose and went down to the main deck where he saw a man sitting wearily against a bulkhead.

"Hey, Mac, are you okay?" asked Buck.

No answer came so Buck asked him again. When he got no answer this time, Buck reached down to feel his pulse. The man was already cold. Buck left and went back to his post.

Up above decks the wounded Patrick was giving out morphine. Page was trying hard to keep breathing above the escaping steam, and dazed by shell fire. Below decks, in engine control room, was Chief Yeoman Cheek reading an old issue of the Reader's Digest.

The huge panel of gauges in front of him was functioning perfectly. The engine was at top speed, the boilers were maintaining a magnificent head of steam, and the blowers were keeping the room quite cool and comfortable. When a command came through, Cheek carried it out, then returned to his reading.

There was nothing else to do.

The noise of the battle was distant and removed. Around him the men stood talking quietly or merely looking at the gauges. In a vague sort of a way they all worried about the 600 pounds of steam coursing through the pipes all around them. Engineers always worry about steam. But they had faith in the armor, faith in the engine, faith in each other.

So Cheek kept on reading the Reader's Digest.

Some reports of injuries could be heard over the phone but not much. The men down in engine control couldn't tell the difference between hits and the noise of their own guns.

It was morning when Cheek walked up onto the deck and saw the destruction. Then he realized, for the first time, how many shells had ripped into the ship during the night.

After he saw the damage, he couldn't sleep for three days.

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